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Ciprofloxacin-Resistant Methicillin-Resistant *Staphylococcus aureus* in New York Health Care Facilities, 1988

LAWRENCE D. BUDNICK, MD, MPH, SAM SCHAEFLER, PHD, AND THE NEW YORK MRSA STUDY GROUP*

Abstract: The emergence in 1988 of ciprofloxacin-resistant methicillin-resistant *Staphylococcus aureus* (MRSA) in New York City was studied in nine hospitals and eight nursing homes. Of the 43 hospitalized patients studied, 21 were admitted from home, while nine of the 12 nursing home patients were transferred from a hospital. Twenty-four of the 55 patients had been treated previously with ciprofloxacin, and 26 had an identifiable risk factor for a nosocomial infection. MRSA was a contributing factor in at least five of the 21 deaths. MRSA resistance to ciprofloxacin was detected within three months of the drug's commercial availability, apparently emerged independently at a number of the health care facilities, and has become widespread. If such resistance is found in a health care facility, ciprofloxacin may not be useful as a first line antibiotic. (*Am J Public Health* 1990; 80:810–813.)

Introduction

Staphylococcus aureus caused a pandemic of nosocomial infections in the 1950s.[1] Shortly after methicillin was introduced into clinical practice, methicillin-resistant *S. aureus* (MRSA) emerged as a prominent cause of nosocomial infections first in Europe and later in the United States.[2–7] Patients can introduce MRSA into a health care facility from the community and cause intra- and inter-institutional spread.[8–11] Ciprofloxacin, an oral fluoroquinolone antibiotic that became commercially available on October 22, 1987, has bacteriocidal activity *in vitro* against MRSA[12] and is reportedly useful for the treatment of infections with susceptible staphylococci of the skin and skin structures,[13] for which it is marketed, bones,[14] and the lower respiratory tract.[15] This report examines the emergence of MRSA resistant to ciprofloxacin in New York City hospitals and nursing homes in 1988.

Methods

The Bureau of Laboratories Phage Typing Unit of the New York City Department of Health is the reference laboratory in New York City for bacteriophage typing of *S. aureus* isolates voluntarily submitted by hospitals, nursing homes, and other laboratories. All facilities do not submit isolates for typing and individual facilities do not necessarily submit all their isolates. The method of phage typing has been previously described in detail.[16–18] In summary, isolates are initially tested for phage susceptibility using the international set of *S. aureus* phages (at routine or 100X routine test dilution concentration) and then are tested using an experimental set of phages (at 100X routine test dilution). In addition, isolates are tested for acid production from mannitol, for growth response on mannitol salt agar plates (Difco Laboratories), and for susceptibility to a standard panel of antibiotics.[17–19] Ciprofloxacin susceptibility has been tested since May 1987 and resistance to ciprofloxacin was defined as a minimal inhibitory concentration ≥4.0 μg/mL. Isolates that differed by ≥3 of 13 findings in their antibiogram and biochemistry profiles were categorized as different.

The Phage Typing Unit MRSA laboratory records were reviewed for all isolates submitted between May 1, 1987 and June 30, 1988 that were resistant to ciprofloxacin. Isolates from 67 patients in 14 New York City hospitals and 14 patients in nine nursing homes (seven in New York City, two in bordering counties) were identified. The infection control practitioners of these 23 facilities were requested to complete for each patient a standardized data collection form based on the Centers for Disease Control National Nosocomial Infections Surveillance System Infection Worksheet. Data were collected concerning demographic factors, medical history, surgical procedures, cultures obtained, antibiotic treatment, hospital course, and outcome. Data were also collected concerning any patient at the facility who had a culture that revealed MRSA resistant to ciprofloxacin that was not submitted to the Phage Typing Unit.

Data on 43 patients were submitted by nine (64.3 percent) of the hospitals which are located in Manhattan (five) and Brooklyn (four) [the five nonparticipating hospitals are in Manhattan (two), Queens (two), and Brooklyn (one)]. Data on 12 patients were submitted by eight (88.9 percent) of the nursing homes which are located in the Bronx (four), Manhattan (one), Queens (one), Westchester (one), and Nassau (one); (the nonparticipating nursing home is in Brooklyn). Patients with positive cultures from normally sterile body sites or who were treated with antibiotics for positive cultures were considered infected; all others were considered colonized.

The data were coded and computerized using DBase III software. Statistical methods used included chi-square tests

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for independence and Fishers exact test. Odds ratios (OR) and 95% confidence intervals (CI) were calculated.

Results

The Patients

The first positive culture for ciprofloxacin-resistant MRSA in New York City was obtained from a patient in late January 1988. Prior to that time, ciprofloxacin-resistant MRSA had not been reported in New York City. Of the 55 patients on whom we have reports, 30 were males, 25 were females, and the age range was 23 to 96 years, with a mean of 67.5 years and a median of 73 years. The mean age of the nursing home patients (71.8 years) was five years greater than that of the hospital patients. The principal diagnoses at admission were cerebrovascular accident (16.4 percent), pneumonia (12.7 percent), atherosclerotic heart disease (9.1 percent), sepsis (9.1 percent), and gangrene/cellulitis (7.3 percent), with other diagnoses accounting for two or fewer patients each. Two patients had the acquired immunodeficiency syndrome (AIDS). In addition, seven patients had insulin dependent diabetes mellitus and four had a reported history of intravenous drug use; none were on hemodialysis.

Almost half of the hospitalized patients were admitted from home, while three-fourths of the nursing home patients were transferred from a hospital (Table 1). The median time from admission to the first positive culture for MRSA was 25 days for 38 of the hospital patients and 340 days for the nursing home patients. Of the nine hospital patients who had a positive culture within one week of admission, five were admitted from home, including the two patients with a positive culture on the day of admission, three were admitted from a nursing home, and one was transferred from another hospital. The one nursing home patient who had a positive culture within one week of admission had been transferred from a hospital. At least 26 (47.3 percent) of the patients had at least one prior culture negative for ciprofloxacin-resistant MRSA and 14 patients had previous treatment with systemic antibiotics.

The culture source of each patient's initial MRSA isolate is listed in Table 2. All eight bacteremic patients and 20 of the 22 patients with positive pulmonary or sputum cultures were hospitalized. Of the 22 patients with a sputum or pulmonary source, 13 had definite radiologic evidence of pneumonia and three had possible radiologic evidence of pneumonia. Almost half of the patients had an identifiable risk factor for a nosocomial infection. Of the 21 deaths, MRSA was estimated by the clinical staff to have contributed to the deaths of at least five.

At least one antibiotic had been used for 52 of the 55 patients and 24 were treated with ciprofloxacin, 19 of whom began taking ciprofloxacin at least two days before the first MRSA positive culture was obtained. None of eight patients with a culture positive for MRSA within one week of admission received ciprofloxacin (data were unavailable for one patient). Twenty-two additional patients who did not receive ciprofloxacin were infected or colonized with ciprofloxacin-resistant MRSA. Ciprofloxacin use among the nursing home patients (75.0 percent) was greater than its use among the hospital patients (OR = 5.6, 95% CI = 1.1, 27.0).

TABLE 1—Places from Which Patients Were Admitted, by Patient's Facility at Time of Culture

	Facility at Culture		
Admitted From	Hospital, n	Nursing Home, n	Total, n
Home	21	1	22
Hospital	6	9	15
Nursing Home	12	1	13
Other/Unknown	4	1	5
Total	43	12	55

TABLE 2—Initial Source of Ciprofloxacin-resistant Methicillin-resistant *Staphylococcus aureus*, Site-Specific Risk Factors, and Deaths

Methicillin-resistant *Staphylococcus aureus* Source	Number	Nosocomial Risk Factor	Number with Risk Factor	Number Who Died
Blood	8	Central venous catheter	7	3
Pulmonary/sputum	22	Ventilator	8	15
Urine	8	In-dwelling catheter	5	2
Wound	14	Previous incision	4	1
Other	3	Invasive procedure	2	0
Total	55	Any noted above	26	21

The MRSA Isolates

The phage susceptibility of the ciprofloxacin-resistant MRSA are listed by facility in Table 3. The distribution of phage types differed between the hospitals and the nursing homes, with 57 percent of the isolates from the hospital patients that were typed susceptible to experimental phage 88 and 64 percent of the isolates from the nursing home patients that were typed susceptible to phages of International Group III. When facilities were grouped by geographic location, no singular or unique pattern was identified.

Ten facilities identified more than one patient with ciprofloxacin-resistant MRSA. The antibiograms, biochemistry tests, and phage typing of the isolates from nine of these facilities are available. Table 4 lists the number of different phage types and antibiogram/biochemistry patterns by facility. Three hospitals and one nursing home identified isolates with multiple phage groups and multiple antibiogram/biochemistry patterns. In one hospital (M-2) there was a close association between the phage groups and the antibiogram/biochemistry patterns, in two of the facilities (hospital K-1 and nursing home B-1) there was a variable association, and in one hospital (M-4) there was no association.

Discussion

In this investigation, we document the emergence of ciprofloxacin-resistant MRSA in New York City health care facilities, which was first noted in 1988.[19] The data are incomplete and represent a minimal account, however, because not all facilities report MRSA and submit all isolates to the NYCDOH and not all facilities that did submit isolates participated in this survey. In addition, this retrospective analysis was limited to MRSA isolates and not other *S. aureus* isolates. Finally, the patients may have been misclassified as being infected or colonized, because patients could have been treated with antibiotics inappropriately and because not all culture data were provided on each patient. Nevertheless, several important conclusions can be reached.

The ciprofloxacin-resistant strains appear to have emerged independently at a number of the health care facilities. This was also seen in the broader survey of reported quinolone-resistant *S. aureus* isolates in New York City.[19]

TABLE 3—Phage Susceptibility of Ciprofloxacin-resistant Methicillin-resistant *Staphylococcus aureus* by Facility

Facility*	International Group 2	International Group 3	Experimental Phage 88	Other Experimental#	Not Typable	Not Typed	Total
Hospitals							
M-1		2				9	11
M-2		5	1		1	1	8
M-3			8				8
M-4			2		1		3
M-5			1				1
K-1			2	1	3		6
K-2						3	3
K-3			2				2
K-4			1				1
Subtotal		7	17	1	5	13	43
Nursing Homes							
B-1	1	1	1				3
B-2		1					1
B-3		1					1
B-4		1					1
X-1			1	1			2
X-2		1				1	2
X-3		1					1
X-4		1					1
Subtotal	1	7	2	1		1	12
Total	1	14	19	2	5	14	55

*Facilities: M = Manhattan, K = Brooklyn, B = Bronx, X = Other locations for nursing homes (1 each in Manhattan, Nassau, Queens, Westchester)

#Experimental phages excluding phage 88

The distribution of ciprofloxacin-resistant MRSA detected may represent either actual differences between hospitals and nursing homes, differences in community flora, or selective underreporting by facilities in other New York City boroughs. If the difference between the facilities is real, it is possible that MRSA isolates with this resistance pattern are transferred only between similar facilities locally, and we did note a few patients who may have been the vectors of transmission between facilities. Although nursing home patients have been prospectively implicated as a source of MRSA in Chicago hospitals,[8] half of the hospital patients we studied came from their homes, and colonized nursing home residents did not appear to be the major source of ciprofloxacin-resistant MRSA in the hospitals. Similarly, although the majority of the nursing home patients came from hospitals, many had a prior culture negative for ciprofloxacin-resistant MRSA and this admission pattern may be the usual one for nursing home residents.

TABLE 4—Phage Group, Antibiogram, and Biochemistry Patterns of Ciprofloxacin-resistant Methicillin-resistant *Staphylococcus aureus* by Facility

Facility*	Number of Isolates	Number of Different Phage Groups	Number of Different Antibiogram/Biochemistry Patterns
M-1	11	1	3
M-2	8	3	3
M-3	8	1	1
K-1	6	3	3
B-1	3	3	2
M-4	3	2	2
X-1	2	2	1
K-3	2	1	2
X-2	2	1	1

*See footnote Table 3.

Ciprofloxacin-resistant MRSA, which contributed to almost one-fourth of the deaths and which resulted in an outbreak that eventually affected over 40 patients in one of the hospitals (Michael S. Simbercoff, MD: personal communication) appears as virulent as other *S. aureus* strains.[30] In this investigation, the majority of patients had MRSA resistant to ciprofloxacin without prior ciprofloxacin treatment. Therefore, ciprofloxacin may not be useful as a first line antibiotic, especially in facilities where ciprofloxacin-resistant MRSA is already prevalent.[21] Although data indicating that the prevention of resistance to ciprofloxacin by combination chemotherapy are few, ciprofloxacin may best be used in combination with other agents.[23-25]

We recommend that isolates of *S. aureus* be tested for susceptibility to ciprofloxacin in all health care facilities where ciprofloxacin is used. This increased testing provides clinicians with additional information necessary to prescribe appropriate treatment and allows additional surveillance opportunities to further define the spread of ciprofloxacin-resistant MRSA. In New York City, the Phage Typing Unit received 717 ciprofloxacin-resistant *S. aureus* isolates from 31 hospitals and 28 nursing homes from July 1 to December 31, 1988, 23 percent of the 3134 MRSA isolates submitted for phage typing (New York City Department of Health: unpublished data).

MRSA, in general, is becoming more problematic to health care facilities in New York. In a 1987 New York State Department of Health statewide survey, 40 (36 percent) of 111 acute care hospitals reported that they were adversely affected by MRSA. Furthermore, 23 outbreaks of nosocomial MRSA were reported in New York City health care facilities between July 1, 1987 and December 31, 1988 (New York State Department of Health: unpublished data). In response, the Department is promoting policies for health care facilities, based in part on those of the Los Angeles County Department of Health[26] and the Centers for Disease

Control[27,28] which emphasize the importance of traditional infection control measures, i.e., surveillance, handwashing, barrier precautions, epidemiologic assessment and appropriate cultures, individualized treatment, and intra- and interfacility communication. Additional prevention and control measures have been described elsewhere[29] and have been discussed in a recent review.[30] Health care facilities may also find the surveillance of certain prescribed antibiotics and their control useful.[30–33] Finally, health care facilities need to work together to control the spread of MRSA and to provide the appropriate level of care for colonized or infected patients.

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Access to Obstetric Care in Rural Areas: Effect on Birth Outcomes

THOMAS S. NESBITT, MD, MPH, FREDERICK A. CONNELL, MD, MPH,
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Abstract: Hospital discharge data from 33 rural hospital service areas in Washington State were categorized by the extent to which patients left their local communities for obstetrical services. Women from communities with relatively few obstetrical providers in proportion to number of births were less likely to deliver in their local community hospital than women in rural communities with greater numbers of physicians practicing obstetrics in proportion to number of births. Women from these high-outflow communities had a greater proportion of complicated deliveries, higher rates of prematurity, and higher costs of neonatal care than women from communities where most patients delivered in the local hospital. (*Am J Public Health* 1990; 80:814–818.)

Introduction

A fundamental precept of modern obstetrics is that adequate prenatal care leads to improved perinatal outcomes for mothers and infants particularly for high risk populations.[1–3] For pregnant women to obtain timely and appropriate perinatal care, they must establish relationships with individual providers: obstetricians, family physicians, midwives, or public health nurses.

In the rural United States—accounting for 23 percent of the nation's population[5]—two-thirds of the obstetrical providers are family or general practitioners.[6] There has been a precipitous decline over the past several years in the number and proportion of family physicians offering obstetrical services in the United States. In 1988, only 29 percent of the members of the American Academy of Family Physicians were offering routine obstetrical care, down from an estimated 40 percent just two years previously.[7,8] Although approximately 43 percent of *rural* family physicians continued to offer obstetrics, this constitutes a 23 percent decline in their participation since 1980.[7,9] The Institute of Medicine reports that thousands of rural physicians stopped offering obstetrical care, leaving hundreds of rural counties without any local source of obstetrical services.[6] Although the cause of physicians eliminating obstetrical care from their practices is multifactorial, the cost of liability insurance and the fear of suits appear to play a major role in their decisions.[6,8–13]

Even in communities with adequate obstetrical care, a certain proportion of women either choose to leave these communities for obstetrical care, or are referred to different physicians or facilities because of specific complications of pregnancy. However, in towns with little or no obstetrical capacity, most women must travel to secure basic prenatal care as well as delivery. As a consequence it becomes less likely that those women will obtain adequate prenatal care.[14] Delays in care of early labor complications may also result.

This study investigates the extent to which local availability of obstetrics is related to perinatal outcomes. We seek to answer the following questions:

- What are the characteristics of rural communities in which the majority of women deliver at a facility other than their local hospital (outflow)?
- Using outflow as a proxy for access to care, is there any difference in the outcome or cost of care for women living in communities with diminished obstetrical access as compared to women who have ready access to local obstetrical care?

Methods

Population Studied

The study was based on all deliveries of women whose primary residence was in a rural area of Washington State and who gave birth during calendar year 1986. The following definitions were used:

- *Rural hospitals* were defined as all non-federal, short-stay, acute care, inpatient facilities of fewer than 50 beds and located more than 15 miles from a city of 30,000 population or greater. Thirty-three of Washington's 90 hospitals met these criteria.
- A *rural area* was defined as the medical service catchment area served by these hospitals.
- A *catchment area* was the aggregate of all zip code areas whose center was closer to a specific rural hospital by public road than to any other hospital facility.
- Distances were based on figures supplied by the Washington State Department of Transportation.

Stratification of Rural Areas by Location of Delivery

A file of all hospital discharges from non-federal, short-stay hospitals in the State of Washington includes data on the place of residence of the patient, hospital of discharge, the DRG (diagnosis related group), and hospital charges. Maternal residence was used to identify all patients living within the 33 rural medical service catchment areas. By comparing the place of residence with the location of the hospital of delivery, we could determine what proportion of all obstetrical deliveries occurred in facilities outside a woman's local hospital catchment area.

The 33 rural areas were stratified into three groups on the basis of these determinations. Areas in which more than two-thirds of deliveries occurred in the local hospital were designated as "low-outflow" communities. "High-outflow" communities were those in which fewer than one-third of deliveries to local women occurred in the local hospital.

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"Medium-outflow" communities were those between these two extremes.

Availability of Obstetrical Services

The availability of obstetrical services in each of the 33 communities was determined through telephone surveys of hospital administrators and directors of nursing. The response rate was 100 percent. Information was obtained as to the number and specialty of all physicians providing obstetrical services in each hospital during the study period (1986), as well as in 1985 and early in 1988. A physician was considered as providing obstetrical services if, in the opinion of the administrator and directors of nursing, the physician was routinely doing deliveries in the hospital; this excluded physicians who delivered only on an emergency basis.

Determining Pregnancy Outcome and Costs

DRGs were used as proxies for obstetrical outcome (Appendix). Maternal complications were defined as all discharges with DRGs 370 or 372. These DRGs are used to designate deliveries—both cesarean section and vaginal—associated with major intrapartum complications, as well as other conditions such as pregnancy-induced hypertension, diabetes, and anemia. The balance of the deliveries were assumed to be uncomplicated for the purposes of this study and included DRG 371 (uncomplicated C-section), 373 (normal vaginal delivery), and 374 and 375 (vaginal delivery with an operating room procedure, such as sterilization). Premature births were defined as babies discharged with DRG codes 386, 387, or 388 all of which referred to premature delivery. DRGs 389, 390, and 391 were defined as full term births.

Hospital charges for neonatal care, as well as source of payment, were also evaluated from the hospital discharge abstracts.

Statistical Analysis

Differences in outcomes between outflow groups were evaluated using chi-square for trend for each outcome measure. Hospital charges for newborns were evaluated by comparing the means of high and low outflow communities, and the confidence interval of the difference between them. In addition, for the same groups, the proportion of newborns with charges greater than $5,000 were compared using the associated 95 percent confidence interval of the difference between those proportions.

Results

Characteristics of Study Communities

Approximately 350,000 people, 8 percent of the population of Washington State, live in the 33 rural medical service areas defined by this study. The 33 hospitals serving these areas represent 37 percent of the 90 acute, short-term, general hospitals in Washington State, but account for only 8 percent of the total licensed acute care beds. These service areas are dispersed throughout the state; 23 of Washington's 39 counties encompass one or more of the study areas. The 5,554 births which occurred to residents of these areas in 1986 represent 8.1 percent of all births to residents of the state during that year. There were 108 physicians practicing obstetrics in the 33 communities during 1986, 93 percent of whom were family or general practitioners; there were eight obstetricians practicing in two low-outflow communities and two medium-outflow communities.

As can be seen from Table 1, both the rural communities and the hospitals that serve them are quite small, with the average service area encompassing 10,592 people and the average hospital having 32 beds. High-outflow communities—those in which more than two-third of all births to local residents did not occur in the local hospital—were smaller than communities where larger proportions of pregnant women delivered in their local community hospital. These high-outflow communities were also somewhat closer to other more sophisticated perinatal facilities, although even for this group the average distance to a Level II facility was 41 miles. Conventional measures of socioeconomic status, such as unemployment rate and the proportion of obstetrical patients enrolled in Medicaid, did not meaningfully differ among the three groups of communities.

The most striking difference between the communities in the outflow groups was the local availability of obstetrical care. By the end of the study period in 1986, only eight of the 13 high-outflow community hospitals still offered routine obstetrical services, with four of the closures occurring since mid-1984. Additionally, three of the eight hospitals which offered obstetrical services in 1986 suspended these services

TABLE 1—Characteristics of Study Communities Stratified by Differential Obstetrical Outflow, Washington State, 1986

Characteristics	Low Outflow (<33%) N = 8	Medium Outflow (33–67%) N = 12	High Outflow (>67%) N = 13	All Communities N = 33
Total number of hospital births to residents of service areas	1,155	2,781	1,618	5,554
Percent of births occurring outside community	19.9	48.8	80	52
Mean miles to Level II nursery	79	63	41	58
Mean beds in local hospital	37	33	27	32
Mean population of hospital service area	11,029	12,318	8,731	10,592
Mean percent of obstetrical patients enrolled in Medicaid	31.3	26	27.4	28.8
Mean percent county unemployment rate (1985)	12.6	11.8	11.1	11.7
Percent of births to women under 18 or over 35 (1986)	9.4	11.0	8.8	9.7
Infant Mortality Rates/1000 births (County rates 1980–83)	11.6	11.8	10.5	11.2

in either 1987 or 1988. The reason given in essentially all of these cases was the decision of local physicians to discontinue offering obstetrics. All of the low and medium-outflow communities continued to offer obstetrics. Figure 1 shows that high-outflow communities had relatively fewer obstetrically active physicians in the year before the study, and that this disparity has become more pronounced during the study year and in the succeeding year. By contrast, there was no significant attrition in obstetric availability in the comparison communities.

Obstetrical Outcomes

Obstetrical outcomes differed systematically across the three groups of communities. As Figure 2 demonstrates, there is a strong association between the proportion of deliveries that occur outside of the community and the rate of complications associated with childbirth. Women living in high-outflow communities were 34 percent more likely to experience birth-associated complications or comorbidity than women from medium-outflow communities, and 67 percent more likely than women from low-outflow communities.

Children of women from high-outflow communities have higher rates of prematurity, a trend significant at the .001 level. Neonatal length of stay—a measure presumably correlated with neonatal outcome—also shows a significant trend across community type.

Access to Care and Perinatal Costs

Table 2 illustrates the difference in hospital charges for newborns used as a proxy for cost for neonatal care across the three community groups. Newborn patients from high-outflow communities have dramatically higher average charges than their counterparts in better served communities.

Although the differences are impressive without regard to insurance type, it appears these differences are mainly the result of patients enrolled in the Medicaid program. It should be noted, however, that infants of lower income women with adverse birth outcomes generating high hospital charges are more likely to be encouraged, and even assisted in enrolling in Medicaid.

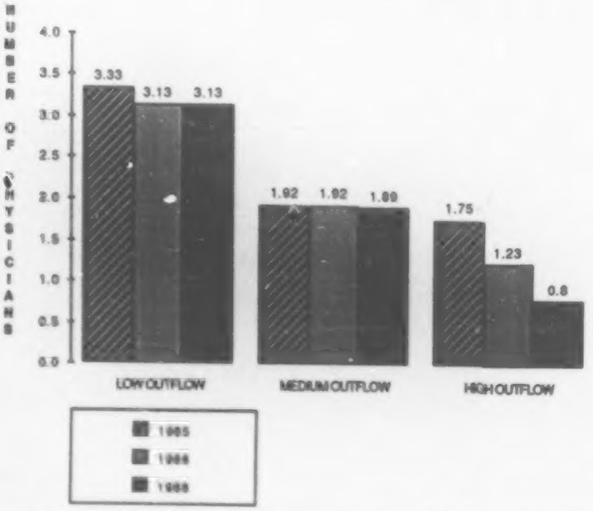

FIGURE 1—Physicians Practicing Obstetrics per 100 Births to Local Women by Community Outflow by Selected Year

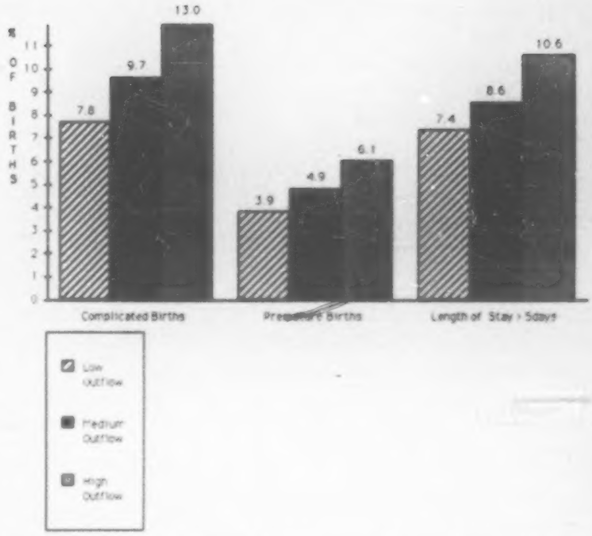

FIGURE 2—Percent of Adverse Birth Outcomes to Rural Washington State Residents by Community Outflow

TABLE 2—Newborn Hospital Charges to Rural Washington Residents Stratified by Community Outflow for Obstetrical Care and Payor Type

	Mean Charges		
	High Outflow N = 1587	Low Outflow N = 1210	Difference (95% CI)
All payors	$2,103	$1,046	$1057 (−$125, $2,239)
Medicaid	$4,627	$1,014	$3613 (−$422, $7,648)
Non-Medicaid	$1,128	$1,061	$67 (−$368, $502)
	Proportion of Newborns with Charges > $5,000		
	High Outflow N = 1587	Low Outflow N = 1210	Difference (95% CI)
All payors	3.6	1.7	1.9 (0.66, 3.14)
Medicaid	6.3	2.1	4.2 (0.54, 7.9)
Non-Medicaid	2.7	1.4	1.3 (−.03, 2.57)

Although a few outliers can generate enormous charges, dramatically increasing the mean, and they undoubtedly had an effect here, newborns with higher charges clearly occurred more frequently in high outflow community populations. As shown in Table 2, there are three times as many babies on Medicaid with charges exceeding $5,000 in the high-outflow communities compared to the low-outflow communities—a measure less affected than average charges by the influence of extreme outliers.

Discussion

The declining proportion of practitioners offering obstetrical services has had a disproportionate impact on rural areas. First, rural areas have fewer physicians per capita than urban regions and thus are more susceptible to changes in the spectrum of clinical services offered by those physicians who do practice in rural America. Second, a larger proportion of deliveries in rural areas have been provided by general and family physicians, a group that has experienced a high rate of attrition from obstetrics.[6,7–13,15]

Out data demonstrate that women living in rural Washington state communities with little or no obstetrical care available locally tend to deliver in hospitals outside the community. These women are more likely to have complicated labor and premature deliveries, and their infants are more likely to have longer and more expensive hospital stays than the children of their rural counterparts who deliver in local facilities communities with greater access to care.

The design of this study does not permit us to conclude that there is a causal relation between impaired access to rural obstetrical care and adverse perinatal outcome, although this appears to be a tenable hypothesis. There are several possible mechanisms which could account for a causal relation between access to care and outcome, however. First, women living in communities without obstetrical services must travel to obtain routine prenatal care, a barrier associated with poorer prenatal compliance.[14] Women on marginal incomes or women without adequate transportation would be likely to delay or forego prenatal care, and might have more difficulty getting to all their prenatal visits. Even if these patients are able to arrange for transportation to other communities, they may encounter difficulties in obtaining obstetrical care in a state like Washington where most physicians limit the number of pregnant Medicaid patients for whom they will provide care.[10]

Second, obtaining obstetrical care and delivering outside one's local community may in itself constitute a risk factor for adverse outcome, even if obstetrical care has been arranged. Patients from remote, rural communities may have difficulty adhering to prenatal protocols or treatment regimens prescribed by physicians in distant communities. There may be significant delays in presentation to the hospital after the onset of labor. And the increased stress—physiological and psychological—associated with travel and parturition in unfamiliar settings may interfere with the normal process of labor.

Nevertheless, there are alternative explanations for the patterns observed here, the first being the possibility that inappropriate care was delivered by local physicians in high outflow communities. This is an unlikely cause for the results in this study for several reasons. First, there was little care available in these communities; five were without any routine obstetrical services. Second, for the 20 percent of the women from high-outflow communities who did deliver in a local hospital, outcomes were actually superior to local deliveries in medium and low-outflow facilities. Finally, of the non-local complicated births which occurred to women from high outflow communities, less than 5 percent came to those non-local hospitals as the result of a transfer.

A second explanation is that because the data are derived from hospital discharge abstracts, we lack precise information about the prenatal, intrapartum, and neonatal course of the patients in the study. DRGs and costs are used as proxies for outcome, and it is possible that there is a systematic bias in which larger urban hospitals are more likely to intervene medically during the intrapartum period, assign DRG codes denoting increased medical intensity, and keep neonates longer in their nurseries than smaller rural hospitals. Even if such a bias is the cause of the apparent differences in biological outcomes, the increased charges and lengths of stay associated with deliveries outside rural communities are real.

A third alternative explanation for the observed disparities is that women from communities with high-outflow are not comparable to the women living in medium- and low-outflow communities. Perhaps the 13 communities in this group have populations of women with higher risks for adverse perinatal outcomes. However, we found no indications that these high-outflow communities differ systematically from those with lower outflow for obstetrical care. Although the high-outflow communities are slightly smaller than the average rural Washington town or medical service area, the situation regarding previous county infant mortality rates (80–83), county unemployment, and the percent of obstetrical patients on Medicaid from these communities is similar to that of communities with less outflow and better outcomes.

A fourth explanation for these results may be that physicians in communities with increased rates of adverse outcomes transfer those high-risk patients to outside facilities prior to labor, thereby becoming a high-outflow community. However, if one notes that high-outflow communities were those in which more than two-thirds of the patients delivered non-locally, and that these communities had only 13 percent complicated births, it is clear that the transfer of an increased number of complicated patients would not change an otherwise low-outflow community into a high-outflow community.

Despite the limitations of this study, the data suggest that recent declines in the availability of obstetrical care in rural areas are associated with poorer perinatal outcomes. From the experience in Washington State it appears that the pivotal event is the decision by rural family physicians to discontinue providing obstetrical services. In many cases this leads to a substantial curtailment or total discontinuation of obstetrical services in the local hospital, causing women who may have previously delivered in their local hospital to travel to other communities for their obstetric care.

Although in this study loss of local services and associated higher rates of adverse outcomes were observed only in a handful of relatively small communities, this may be the leading edge of a more pervasive phenomenon. Although the problem is more graphic and easily demonstrated in rural populations, impaired obstetrical access may have the same social and biological consequences in urban settings.[16]

This study suggests that programs that maintain local availability of obstetrical care may improve perinatal outcomes in a cost effective fashion, since infants from high-outflow rural communities generated hospital charges twice as high as infants from low- and medium-outflow communities. The excess charges were more than $1.5 million during 1986 alone, most of it paid for by public subsidies through the Medicaid program. This does not include additional costs in the post-hospital period which have been shown to be higher for Medicaid infants whose mothers received inadequate prenatal care.[17]

In conclusion, this study demonstrates an association between diminished rural access to obstetrical care and perinatal outcomes for women who travel outside their local communities for that care. If a causal relationship exists, society would benefit both medically and economically from providing a solution to the problems which stem from a diminishing number of obstetrical providers.

ACKNOWLEDGMENT

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APPENDIX

Codification of Diagnosis Related Groups

DRG	Abbreviated Title
Coded as Complicated Birth	
370	Cesarean section with complications or comorbidity
372	Vaginal delivery with complicating diagnosis
Coded as Uncomplicated Birth	
371	Cesarean section without complications or comorbidity
373	Vaginal delivery without complicating diagnoses
374	Vaginal delivery with sterilization and/or D & C
375	Vaginal delivery with operating room procedure except sterilization or D & C
Coded as Premature Neonate	
386	Extremely premature neonate
387	Premature with major complications
388	Premature without major complications
Coded as Term Neonates	
389	Full term neonate with major problems
390	Neonates with other problems
391	Normal newborn

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'Late Breaker' Session on Injury Control Invites Abstracts

The Injury Control and Emergency Health Services special primary interest group of the American Public Health Association has announced it will again feature a "late breaker" session during the APHA upcoming 118th annual meeting in New York City. The session will be held on Tuesday, October 2, 8:30 am–10:00 am, and will feature work completed within the last few months--after the deadline for consideration in the regular symposia of the APHA annual meeting.

Abstracts of 250 words or less will be accepted by the Injury Control SPIG until August 15, 1990. Please send the abstract, title of the paper, authors' name, address and telephone number to: Richard Waxweiler, Division of Injury Control, Centers for Disease Control, Mail Stop F-36, Atlanta, GA 30333. Tel: 404/488-4695.

The Relation of Obstetrical Volume and Nursery Level to Perinatal Mortality

Jennifer A. Mayfield, MD, MPH, Roger A. Rosenblatt, MD, MPH, Laura-Mae Baldwin, MD, MPH, Joseph Chu, MD, MPH, and James P. LoGerfo, MD, MPH

Abstract: We investigated the relation of hospital delivery volume and nursery technology level to perinatal outcome in 226,164 White singleton births in Washington State, 1980–83. Level III facilities (neonatal intensive care unit) were defined by the state licensing commission. We defined the Level II (intermediate) and Level I (normal newborn) facilities using published criteria. Infants under 2000 gm born in Level III facilities had half the risk of perinatal death compared to those born in a Level I or II facility. No significant improvement was noted among level or volume groupings for normal birthweight infants. A loglinear regression model of hospital perinatal death rates showed that when birthweight and maternal risk were controlled, obstetrical volume added minimal explanatory power to level of nursery care. (*Am J Public Health* 1990; 80:819–823.)

Introduction

Many experts believe that the decreasing rates of neonatal and perinatal death observed in the United States over the past several decades are due to more effective technological interventions coupled to regionalization, a process which optimizes access to that technology.[1,2] Regionalization is based on a tiered structure of facilities linked by referral patterns whereby high-risk mothers and newborns are triaged to the central facilities with increased technology and staff. Most investigators have noted a twofold improvement in outcome for infants under 2500 gm when born in a high technology facility (Level III) compared to birth in a low technology facility (Level I).[3–7]

A close correlate of high technology is volume, since a high volume of patients is required to justify the expense of purchase, maintenance, and staffing of high technology. This high volume is also thought to lead to improved skill in the use of the technology. Work by Luft and others has shown a positive relation between the quality of care and hospital volume of some surgical procedures and medical diagnoses.[8–10] Increased obstetrical volume also appears to impart some benefit in obstetrical outcome, with authors noting the death rates for infants delivered in facilities with over 2,000 deliveries/year to be half of the rate of those born in facilities delivering less than 500 per year, particularly for the low birthweight infants.[3,11,12]

The relation among volume, technology level, and outcomes is unclear. Most of the studies of obstetrical volume are confounded by the presence of high technology. For example, when Williams evaluated the relation of hospital characteristics to mortality, obstetrical volume became insignificant when variables that normally accompany higher technology, such as higher number of specialists and C-sections, were added to the regression.[12]

This study was undertaken to establish more clearly the relation of hospital obstetrical volume and neonatal nursery technology to outcome by using the perinatal mortality rate as the outcome measure of quality. Also, we desired to explore the relation between obstetrical volume and the nursery level of care.

Methods

Perinatal Data

Washington State birth-death linked records and fetal death records were obtained for 1980–83. The analysis was restricted to White singleton births because of the very small number of other racial births and their marked association with high volume hospitals. All White singleton births over 1000 gm which occurred in hospitals that routinely offer obstetrical care in Washington State were included. The hospital of birth (not of death) was identified from the record, and births were grouped by hospital. Perinatal death was defined according to the World Health Organization, i.e., all fetal deaths over 1000 gm and all live births over 1000 gm which died within one week of birth (early neonatal deaths).[13] Births under 1000 gm and those without a recorded birthweight were excluded from the study. The birthweight was stratified by 250 gram intervals for analysis, then grouped by 500 grams for presentation in the tables.

The fetal file required special handling because no birthweight was recorded for 450 cases (23 percent) of the fetal death file. We obtained 91 of the missing birthweights from a chart review being conducted by the Washington State Department of Social and Health Services, Division of Health, Epidemiology Section.[14] The last menstrual period was recorded on 223 of the records sans a birthweight, enabling us to calculate a gestational age. We elected to impute birthweights based upon this calculated gestational age, using the mean birthweight per gestational week from the 1981 live birth file as a standard. There were 171 fetal deaths without a birthweight or gestational age recorded. (Further details can be obtained from the first author.)

We controlled for maternal risk factors recorded in the certificate which might influence the choice of hospital.[15,16] A high-risk status was declared if any of the following were noted on the certificate: all forms of diabetes, hypertension, pyelonephritis, pregnancy-induced hypertension, acute urinary tract infection, surgery, tumor, epilepsy, prior fetal death, pre-eclampsia, eclampsia, Rh-sensitization, abruptio placenta, placenta previa, or "other medical problems."

Hospital Characteristics

The obstetrical volume per year was calculated as the average of all deliveries performed in that facility over the four study years, 1980–83.

All six Level III facilities currently recognized and licensed by the state as Level III were assigned Level III status. We assigned Level II status using published guidelines

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(see Appendix).[17] The remainder of the facilities were considered Level I facilities.

Data Analysis

Simple descriptive analyses were used to examine the relation between variables and to calculate the relative risks of death. Confidence intervals were developed using the Mantel-Haenszel Chi-square statistic test-based method.[18] A log-linear model was created, using the Generalized Linear Model (GLIM) statistical package. The dependent variable was the likelihood of death in each hospital and the independent variables were obstetrical volume, nursery level, maternal risk status, and birthweight. The model additions were tested for significance using the deviance based method, where the model is compared to the nested model by comparing the difference in scaled deviance and difference in degrees of freedom in a Chi-square contingency table.[19]

Results

Data Description

Washington State Department of Vital Statistics recorded 280,801 live births, 1,377 early neonatal deaths, and 2,046 fetal deaths for the study years 1980–83. We excluded live births and fetal deaths that were delivered in non-obstetrical hospital settings (6%, 6% and 6%), multiple gestations (i.e., twins) (2%, 11% and 9%), and of non-White race (12%, 12% and 17%). White singletons born in an obstetrical hospital that had a birthweight under 1000 gm (live births (.3%), neonatal deaths (41%) and fetal deaths (32%)) or were missing a recorded birthweight (live birth (.4%), neonatal deaths (4%), and fetal deaths (4%)) were excluded from analysis. There were 225,287 live births, 495 early neonatal deaths and 877 fetal deaths of White singletons which occurred in the 90 Washington state hospitals which routinely offer obstetrical care. This made a total of 226,164 births and 1,372 perinatal deaths.

Table 1 shows the distribution of the 90 hospitals between facility level and obstetrical volume groups. A high degree of correlation is noted between level and obstetrical volume groups. The distribution of births and perinatal deaths between level and obstetrical volume along with the crude perinatal mortality rate is shown in Table 2. Level III facilities had the highest crude death rate.

Stratified Analyses

The birthweight distribution was highly related to the hospital's level of technology. The distribution of births among the three levels is shown in Table 3, showing a significant shift in birthweight distributions across level. The lower the birthweight, the more likely the infant to be born in a Level III setting. While Level III hospitals deliver only 22 percent of all births, almost 40 percent of low birthweight infants (1500–2500 gm) and 67 percent of very low birthweight infants (1000–1500 gm) were born in Level III settings. The distribution of births among the five volume groups is similar to the distribution among levels, with low birthweight babies concentrated in larger volume facilities.

TABLE 1—Distribution of Hospitals Among Nursery Levels and Obstetrical Volume Groups

	Volume Groups (births/year)					
Nursery Type	<200	201–500	501–1000	1001–2000	>2000	Total
Level I (normal)	31	22	13	7	0	73
Level II (intermediate)	0	0	1	5	5	11
Level III (intensive care)	0	0	0	0	6	6
Total	31	12	14	12	11	90

TABLE 2—Crude Perinatal Mortality for the Level and Volume Groups

	Deaths	Births	Crude PNMR (deaths/1000 births)
Level I (normal)			
<200 births/yr	65	8,267	7.8
200–500 births/yr	201	23,275	8.6
500–1000 births/yr	289	30,928	9.3
1000–2000 births/yr	301	40,518	7.4
Level II (intermediate)			
500–1000 births/yr	20	2,337	8.5
1000–2000 births/yr	303	27,827	11.2
>2000 births/yr	314	43,261	7.2
Level III (intensive care)			
>2000 births/yr	793	51,161	15.5

TABLE 3—Distribution of Births Among Level by Birthweight

	Level			Total	
Birthweight	I (%)	II (%)	III (%)	(%)	(n)
1001–1500 gm	17	16	67	100	924
1501–2000 gm	25	20	55	100	1,829
2001–2500 gm	39	29	32	100	6,214
2501–3000 gm	45	31	24	100	27,136
3001–3500 gm	46	32	22	100	79,229
3501–4000 gm	46	33	21	100	76,900
>4001 gm	46	34	20	100	33,932
Total	45	33	22	100	226,164

The birthweight-specific perinatal mortality rate by level of facility is shown in Table 4. The infant under 2000 gm was twice as likely to die if born in a Level I or II facility compared to a Level III. For the infant over 2000 gm, level of care had little influence on survival rates. The birthweight-specific perinatal mortality rate is compared across obstetrical volume groups and is similar to that across level of facility. The infant under 2000 gm had twice the mortality rate in facilities with less than 2,000 deliveries per year when compared to those born in facilities with more than 2,000 deliveries per year, while little difference existed between obstetrical volume groups for infants over 2000 gm.

TABLE 4—Birthweight-Specific Perinatal Mortality Rates by Level (Deaths/1000 births)

	Level			
Birthweight	I	II	III	Total
1001–1500 gm	459	358	175	253
1501–2000 gm	170	150	68	110
2001–2500 gm	31	38	39	36
2501–3000 gm	7.8	7.6	11.4	8.6
3001–3500 gm	3.5	2.8	3.0	3.2
3501–4000 gm	1.8	1.5	2.3	1.8
>4001 gm	2.2	2.8	3.7	2.7

Loglinear Regression

The loglinear regression models are shown in Table 5. The nested model used for comparison to determine the significance of the new variable is noted in the second column. As expected, the main effect of birthweight (Model B) was by far the most important variable, with a smaller contribution made by the addition of risk status (Model D), nursery level (Model E) but not the addition of obstetrical volume (Model F). The two major interactions noted in the stratified analyses between "birthweight—risk" (Model H) and "birthweight—level" (Model J) made significant improvements in the model. The addition of volume (Model K) made a significant addition to the model, indicating that volume had an effect above and beyond nursery level.

The model using the interaction between level and volume (Model L) was discarded since the large number of empty volume-level combinations left only one interaction term in the model (see Table 1). The addition of interaction between "volume-risk" (Model M) was also significant, but made the model very complex.

Unfortunately, there is no method currently available to calculate confidence intervals for the various models, since the models include interaction terms. Because the data is so large, most variable additions were statistically significant. However, when parameter estimates were converted into perinatal mortality rates and compared for Model K and Model M, the clinical significance was minimal. Based on this finding, Model K was chosen as the final model.

To provide some clinical perspective of this complex model created by the loglinear analysis, we calculated the number of deaths that would have occurred if all infants had been born in one type of a facility. For infants weighing 1000–2500 gm, the Level III facilities with over 2,000 births/year appeared most advantageous, and for infants over 2500 gm the Level I facilities with 1,000–2,000 births/year appeared most advantageous. Table 6 shows the number of deaths that would have been expected if all births had occurred in either Level I facilities with 1001–2000 births/year or in Level III facilities with >2000 births/yr.

TABLE 6—Observed Deaths and Deaths Predicted from the Model If All Births Occurred in One Type of Facility

Birthweight	Observed	Level I Volume 1000–2000	Level III Volume >2000
1000–1499 gm	234	425	213
1500–1999 gm	201	316	130
2000–2499 gm	221	204	264
2500–2999 gm	234	232	306
3000–3499 gm	251	301	281
3500–3999 gm	139	143	179
4000–4500 gm	47	35	81
>4500 gm	45	45	62
Total	1372	1701	1517

Discussion

The potential limitations of this study include the quality of the vital statistics data. First, missing data, inaccuracies, and underreporting could bias the results, especially if they occurred preferentially in selected level or volume group facilities. However, the failure to record birthweight was evenly distributed among all levels and volume groups of hospitals, minimizing this concern. Other studies comparing medical records to Washington State Vital Statistics records have noted no correlation between type or size of facility and recording omissions.[14,*] Second, the elimination of cases without birthweight creates an underestimation of the true birthweight-specific perinatal death rates, while the imputation of fetal cases using standards from live births would overestimate these rates. Third, certain variables of interest that may have affected the risk classification, such as smoking status of the mother and educational attainment, were not available on these records.

Our study's main purpose was to explore the relation between obstetrical volume and nursery level of care. While obstetrical volume and nursery level are highly correlated, the loglinear analyses indicate that nursery level has a stronger influence on the perinatal mortality rate. Technology, rather than the volume effect, appears most beneficial in lowering perinatal mortality rates.

TABLE 5—Loglinear Models Predicting Mortality Rates

	Comparison Model	Change in Scaled Deviance	Change in Degrees of Freedom	p value
Main Effects Models				
A. Grand mean	—	—	—	—
B. Birthweight	A	3523	20	<.001
C. Risk	A	290	1	<.001
D. Birthweight + Risk	B	18	1	<.001
E. Birthweight + Risk + Level	D	14	2	<.001
F. Birthweight + Risk + Level + Volume	E	0	6	>.999
Interaction Models				
G. Birthweight + Risk * Level	E	31	2	<.001
H. Birthweight * Risk	D	117	20	<.001
I. Birthweight * Risk + Level	E	116	14	<.001
J. Birthweight * Risk + Birthweight * Level + Risk * Level	I	117	40	<.001
K. " + Volume	J	141	4	<.001
L. " + Volume * Level	K	52	1	<.001
M. " + Volume * Risk	K	55	4	<.001

*Indicates the inclusion of the main effects of both variables plus the interaction term (Z * Y = Z + Y + (Z × Y).

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*Connell FA, Persing JP: Needs Assessment Study of High-risk Perinatal Services. Perinatal Data Base Project Assessment Report No. 5, unpublished report, May 1985.

The benefits from technology (and to a lesser extent, volume) were not enjoyed by all groups of infants. The greatest benefits were achieved by low birthweight infants (<2500 gm) with a two-fold improvement in perinatal mortality rates noted when born in Level III nurseries compared to Level I or II. This finding is similar to other evaluations of regionalized nursery systems over the past decade.[3–7] The normal birthweight infant, on the other hand, realized no net benefit from the technology-intense Level III facility. In fact, they had marginally better survival when born in the low technology setting of Level I hospitals than if born in a Level III facility, but this difference was not statistically significant. This finding is very similar to an analyses of the term, normal birthweight infant in an urban setting (New York City),[20] but different from Rosenblatt's finding in New Zealand[21] of statistically higher mortality for normal birthweight infants in Level III, high volume facilities. The lack of benefit for the normal birthweight infant in a high volume, technology intense setting could possibly be due to the failure of Level III facilities to recognize and record high-risk conditions. Because this potential ascertainment bias among nursery levels seems counter-intuitive, other explanations for the lack of benefit, and even possible harm, should be explored.

Perhaps the most interesting finding of this study was that Level II facilities did no better with infants weighing under 2000 grams than did Level I facilities. Level III facilities are approved by state authorities according to set criteria in Washington State, but no such external independent review occurs for Level II facilities. The published criteria differentiating a Level II is quite vague, specifying only that a "selected number of other services" would be offered above and beyond a normal nursery. Our Level II classification system included facilities that self-designate themselves "Level II+" and excluded hospitals offering fewer types of Level II services. Our conservative classification system should have exaggerated any possible difference between Level I and II. Prior evaluations of the influence of level have noted no improvement of Level II over Level I.[6,20,21] No evaluation to date has justified the division of nurseries into a three-level system.

The improvement in perinatal mortality rates in Level III compared to Level I facilities has been credited to the presence of neonatal intensive care units, but the specific features of the unit that ensure this improvement are unknown. Other factors which may influence survival include resuscitation capabilities (due to a practice effect), lower rates of "untreatable" conditions such as malformations, or a selection bias where less severe conditions present with sufficient time for transfer to a Level III, while more severe conditions present acutely to the Level I facility, prohibiting transfer or effective treatment.[22,23] Small area population based studies would assist in clarifying the influence of these factors.

The benefits and risks of regionalization should be evaluated from a system-wide perspective, taking into account all segments of the population. Our model simulation with all births occurring in Level I facilities predicted a marked increase in perinatal mortality, experienced especially by the low birthweight infant. This is consistent with the observations that perinatal mortality rates have improved as low birthweight infants have been centralized into Level III facilities. The model also predicts a higher number of deaths if all infants were centralized to a Level III facility, mainly from a large number of normal birthweight infants dying at a slightly higher rate. We suggest that the current system of intrauterine transfer is closer to an optimum composition, with most of the low birthweight infants being born in Level III facilities, and the majority of low-risk, term infants being born in Level I facilities. Further efforts to centralize the system, i.e., closing smaller hospitals, will be of no benefit to the normal, low-risk infant, and may even pose a risk to the normal birthweight infant.

The relation of volume to perinatal outcome is of more than academic interest to states with large rural populations such as Washington State. In 1984, over one-third of Washington State hospitals had less than 500 deliveries per year, the cutoff recommended by federal health planners in 1977 to ensure hospital quality.[24] These small hospitals now find themselves affected by the public's belief that big and better equipped hospitals offer better quality care and are bypassed by low-risk, term women who seek delivery in a Level III facility. This drain of obstetrical cases, compounded by other financial pressures and the loss of obstetrical providers, has forced many rural hospitals to eliminate their obstetrical services, resulting in access problems and even adverse outcomes for rural women.[25] Health planners and patients should be reassured with the knowledge from this and other evaluations[26] that the low volume Level I facility is an appropriate and safe location for birth for the term, low-risk woman.

In summary, the effect of hospital technology upon perinatal mortality appears to be greater than the effect of volume, but this benefit is enjoyed mainly by the low birthweight, high-risk infant. The evaluation of practices and policies which encourage transfer of obstetrical patients between facilities must consider the outcomes for all segments of the population to guide wise policy decisions and efficient resource allocation.

APPENDIX

Criteria for Level I and Level II Facilities

Criteria to differentiate Level II from Level I facilities were based upon guidelines published by the American College of Obstetrics and Gynecology and the American Academy of Pediatrics.[17] Our Level II criteria included:

- the presence of obstetric and pediatric medical staff,
- 24 hour in-house capability of resuscitating a newborn,
- maintenance of peripheral or umbilical lines, and
- short-term respiratory support.

A hospital had to meet all of the above criteria to be classified as a Level II facility. Information on nursery services and practices during 1980–83 was obtained by telephone interview with the hospital staff. Eleven hospitals met our criteria for Level II designation, and the remainder were labeled as Level I. The designation was reviewed and approved by the neonatologist who chairs the Washington State regionalization program.

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Call for Abstracts

APHA 'Late-Breaker' Epidemiology Exchange Session

The Epidemiology Section will sponsor a "Late-Breaker" Epidemiology Exchange on Wednesday, Oct. 3, 1990, 2:00–5:00 pm, at APHA's 118th Annual Meeting to be held in New York City, Sept. 30–Oct. 4. The Exchange will provide a forum for presentation of investigations, studies, methods, etc., which have been conceived, conducted, and/or concluded so recently that abstracts could not meet the deadline for submission to other Epidemiology Sessions. Papers submitted should report on work conducted during the last 6–12 months.

Abstracts should be limited to 200 words; no special form is required. Abstracts should be submitted to Robert A. Gunn, MD, Division of Field Services, Epidemiology Program Office, Building 11 South, Mailstop F-15, Centers for Disease Control, Atlanta, GA 30333—Telephone: 404/639-0336; FAX 404/639-0277, and must be received by *August 13, 1990*. Receipt of abstract will be acknowledged by postcard and acceptance will be decided by August 17, 1990.

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Infectious Disease Control in a Long-term Refugee Camp: The Role of Epidemiologic Surveillance and Investigation

CHRISTOPHER J. ELIAS, MD, BRUCE H. ALEXANDER, MS, AND TAN SOKLY

Abstract: This report demonstrates the role of epidemiologic surveillance and investigation in the control of infectious diseases in a long-term refugee camp. The applications of simple epidemiologic methods in a refugee camp on the Thai-Cambodian border are described for a one-year period. The development of a Health Information Office facilitated the collection of demographic and vital statistics data, administration of a disease surveillance system, regular monitoring of hospital and outpatient discharge diagnoses, and investigation of disease outbreaks. This office also organized community health education campaigns and disease control efforts. Examples of specific disease investigations are provided to demonstrate the utility of epidemiologic surveillance in the control of infectious disease. We conclude that simple epidemiologic methods play an important role in health planning in long-term refugee camps. (*Am J Public Health* 1990; 80:824–828.)

Introduction

There are currently more than 12 million refugees throughout the world.[1] Disease and famine often accompany the movements of refugees, as health and nutritional systems are disrupted by strife. Refugee camps are generally perceived as temporary structures requiring immediate, short-term assistance. Unfortunately, persistent war in the Middle-East, Afghanistan, Sub-Saharan Africa, and Southeast Asia has created refugee camps that require long-term assistance. These camps have become permanent settlements and are now home for the majority of the world's refugees. The health care problems of long-term camps differ from those of short-term camps; the primary tasks are health maintenance, nutritional support, community development, and training of refugee health workers.[2] These tasks are often more difficult than the highly publicized crisis management necessary during the emergency phase of refugee relief operations. The permanence of these camps, combined with the difficulty in obtaining ongoing support, demands innovative planning to effectively allocate scarce health resources.

The importance of epidemiologic assessment for public health planning and resource allocation has been emphasized in emergency assistance situations.[3,4] The successful use of simple epidemiologic methods has been demonstrated in the emergency phase of the Cambodian and Ethiopian refugee crises.[5,6] Epidemiologic assessment is equally important for dealing with the health concerns of long-term camps.[7] Effective disease surveillance and outbreak investigation can help direct public health interventions. Analysis of mortality trends and nutritional status can be used to evaluate the effectiveness of assistance programs.[8,9] Knowledge of disease patterns can inform clinical practice and guide resource allocation decisions. Finally, this information may be useful in designing training programs and orienting expatriate personnel. This paper reports our experience with epidemiologic surveillance of infectious diseases in the Site 2 South encampment for Cambodian refugees on the Thai-Cambodian border.

Methods

Following the Vietnamese invasion of Cambodia in 1979, there was a large influx of Cambodian refugees into camps in Thailand. These refugees were physically, mentally, and nutritionally exhausted after nearly a decade of war and four years of hardship under the Khmer Rouge. Several reports have described the health conditions in these early camps.[10–12] Ten years later there are still approximately 350,000 refugees in eight camps along the Thai-Cambodian border. Site 2, home to over half these refugees, is divided into North and South. Site 2 South has a population of approximately 70,000, or roughly 20 percent of the border refugee population.

The age distribution of Site 2 South is skewed toward the very young. Twenty-three percent of the population is under 5 years of age, and 43 percent is under 15.[13] The camp is severely overcrowded, with only 33 sq.m./person including public lands.[14] There is no ground water in Site 2, requiring that water be brought long distances by truck at considerable expense and resulting in a chronic shortage of water for personal hygiene. The average water ration is only 20 liters/person/day, significantly below the ideal of 100 liters/person/day recommended by the World Health Organization.[15] There is no running water, and the sewer system consists of open ditches between rows of houses. In the dry season these sewers are stagnant pools of waste. In the rainy season they quickly overflow, flooding nearby houses.

The population is totally dependent on external food supplies. The acute malnutrition rates in children under age 5 years, which were very high (>13 percent) in the acute phase of the refugee crisis, had stabilized at approximately 5 percent by 1985.[15] The prevalence of chronic malnutrition (stunting), however, remains high.[13] The diet consists primarily of rice and canned fish. The United Nations World Food Program supplies a food basket calculated to supply sufficient protein and calories. It is common, however, for camp residents to barter away some of their food aid on the black market, gaining variety at the cost of nutritional value. The persistence of significant malnutrition despite the provision of adequate protein and calories arises in part from this use of rice as the primary market exchange commodity; a phenomenon exacerbated by severe under-employment.

Humanitarian assistance for these refugees is provided through the UN Border Relief Operation (UNBRO), which supports and coordinates several voluntary agency health service programs in the camps. The American Refugee Committee has the responsibility for providing curative health services for Site 2 South; their hospital and two

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outpatient clinics are the only curative health facilities serving Site 2 South. Maternal child health services, including antenatal screening, routine immunizations, and growth monitoring, are provided by a separate voluntary agency and are not covered by this report.

The hospital has dirt floors and lacks electricity or refrigeration. There are five wards: adult medicine, surgery, pediatrics, obstetrics, and a feeding center for severely malnourished children. During the year described by this report, the hospital had an average daily census of 223 patients. All wards are staffed and supervised by Cambodian health workers, nurses, midwives, and medical assistants. The expatriate staff, consisting of three nurses, two doctors, and a midwife, serve primarily as consultants and teachers. Laboratory facilities are limited to malaria smears, ova and parasite examinations, Gram and Acid Fast stains, hand-spun urinalyses, and colorimetric hemoglobin determinations. There are no chemistry, serology, or microbiologic culture facilities available. A mobile radiologic facility is available one morning a week.

A Health Information Office was developed by the American Refugee Committee to coordinate epidemiologic surveillance and investigation. This office was staffed by Cambodian and expatriate epidemiologists working closely with hospital and outpatient clinic staff, community leaders, and community service providers. The responsibilities of the epidemiologists included: collection of demographic and vital statistics data, administration of a reportable disease surveillance system, compilation of hospital and outpatient discharge diagnoses, outbreak investigation, and facilitation of clinical studies. The office also organized community health education campaigns and served as a source of information for the many programs involved in health promotion activities in Site 2.

Vital Statistics

Demographic data, obtained from the Cambodian camp administration, were derived from a family registration system maintained for the purpose of distributing relief materials. Monthly figures reflected population changes resulting from births, deaths, in-migration, and out-migration. This information was used as the basis for vital statistics. The receipt of additional relief supplies served as a powerful incentive to complete birth registration. Monthly consultations with the Buddhist monastery operating the camp's only crematorium, and the Khmer Moslem Association, served as a mechanism for death verification. Names and ages of deceased individuals were recorded, but reliable information concerning the cause of deaths occurring outside the hospital was typically unavailable. This method of death ascertainment was generally complete; however, some underreporting of neonatal deaths may have occurred because of the occasional practice of burying very young infants.

Reportable Diseases

The Health Information Office also administered a program to allow the prompt identification of diseases requiring immediate public health interventions: cholera, diphtheria, tetanus, measles, pertussis, encephalitis, dengue hemorrhagic fever, rabies, polio, typhoid, meningococcemia/meningitis, and sexually transmitted disease. The occurrence of any of these conditions was to be reported to the office within 24 hours, along with atypical presentations of more common diseases (e.g., the occurrence of malaria in a child). Contacts of incident tuberculosis and leprosy cases were investigated by a separate program. Given the extremely high prevalence of tuberculosis in Southeast Asia, a comprehensive program for the management of this disease had been developed previously, and is reported elsewhere.[16]

Hospital Discharge Data

At the time of hospital discharge a senior Cambodian medical assistant or midwife, in consultation with an expatriate health professional, recorded a discharge diagnosis. This diagnosis was entered into a log book in each ward, along with the patient's age, sex, name, and address. Precarious security conditions and emergency camp relocations have prevented the development of a permanent medical record system. Hence, the ward log books provided the only data available for retrospective analysis. Diagnostic accuracy and complete reporting were encouraged by random review of charts by clinical supervisors. Unfortunately, the volume of patients seen in the outpatient facilities (average monthly visits >18,000) prohibited complete recording of outpatient diagnoses. On Monday of each week all outpatient diagnoses were recorded and reviewed. During disease outbreaks, the office attempted to identify all outpatient cases, conducted home visits, and was involved in public educational campaigns targeted at curtailing the spread of disease.

Analysis

The results reported below were drawn from the activities of the Health Information Office, June 1987—May 1988. Population figures for January 1, 1988 were used in the computation of age-specific mortality and hospitalization rates. Analysis of the monthly population totals indicated that the population increased steadily throughout the year, and that this mid-year estimate was within 1 percent of the actual annual population average. By applying proportions from 1988 UNBRO demographic data[17] to these population figures, estimates for specific age intervals were obtained.

Results

Vital Statistics

During the study year, 3,261 births and 256 deaths were reported. The estimated crude birth rate was 46.3 per 1,000 population, the crude death rate 3.6/1,000 population. The infant mortality rate (infant deaths/1,000 live births) was estimated to be 27.3. The estimated under-5 mortality rate (deaths in children under-5/1,000 live births) was 33.4. Both the infant and under-5 mortality rates can potentially be biased by migration. During the study year there was a net in-migration of 4,024 people; however, only approximately 5 percent of these new arrivals were children under-5.

Table 1 shows the age- and sex-specific mortality rates. In general, mortality rates were low and resulted primarily from infectious diseases. Mortality rates for males were greater than those for females in the under-5 and some adult age groups. The higher mortality in male children was largely attributable to prematurity, neonatal sepsis, and acute respiratory illness.

Analysis of the cause-specific mortality rates for adults revealed the excess in male deaths to be entirely attributable to violence or malaria. There were 11 deaths from falciparum malaria in men and none in women. Epidemiologic investigation of exposure history revealed that most cases of falciparum malaria occurred in persons who had recently been outside the camp. These were mostly men involved with military or market-related activities who were exposed to the malarial parasite in Cambodia and subsequently returned to

TABLE 1—Age- and Sex-Specific Mortality Rates for Site 2 South, Thailand, June 1987 through May 1988

Age Group (years)	Population		Deaths/1,000/year*	
	Male	Female	Male	Female
<1	2075	1755	28.9 (60)	18.2 (32)
1–4	6630	6377	2.7 (15)	1.6 (10)
5–14	6953	7321	1.3 (9)	1.0 (7)
15–24	6702	4825	1.6 (11)	1.7 (8)
25–34	7992	6850	1.1 (9)	1.6 (11)
35–44	3046	3611	3.3 (10)	2.2 (8)
45–54	1290	1350	10.9 (14)	8.2 (11)
55–64	789	979	10.1 (8)	8.2 (8)
≥65	358	675	53.1 (19)	13.3 (9)
TOTAL	35835	33743	4.3 (155)	3.1 (104)

*Number of deaths in parentheses.

the camp for treatment. There was no evidence of sustained malarial transmission in the camp.

Reportable Diseases

An outbreak of dengue hemorrhagic fever in the summer of 1987 demonstrated the importance of maintaining a reportable disease surveillance system. This disease is a relatively rare, but potentially life-threatening complication of dengue. In 1987 there was a large outbreak in Thailand, with over 63,000 cases reported from 60 provinces in six months.[18] Cases began appearing in Site 2 in May 1987. Figure 1 plots the course of this outbreak in Site 2 South. The reportable disease system allowed the Health Information Office to quickly identify the first cases of the outbreak.

Prompt efforts to control the Aedes mosquito vector included pesticide spraying of houses bordering those of index cases, larval control efforts, and an extensive community education program. The latter included "dengue day" on which the primary school children were given the day off to collect larvae in competition for prizes. The combined effect of these efforts was to plateau the incidence of dengue hemorrhagic fever in the camp.

Only two cases of tetanus were reported, and no cases of pertussis, diphtheria, measles, or polio. The Health Information Office identified six isolated cases of meningococcal illness and promptly located and treated household and clinical contacts with antibiotic prophylaxis. No outbreaks of meningococcal illness occurred.

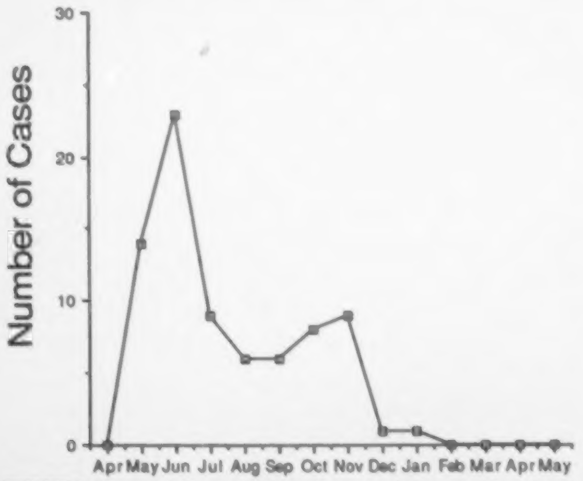

FIGURE 1—Presumed Cases of Dengue Hemorrhagic Fever in Site 2 South: 1987–88

The Health Information Office was also involved in the control of rabies, which is endemic in the dog population of Thailand. In October 1987, a dog in Site 2 was found to have rabies, confirmed by examination of the brain at the Science Division of the Thai Red Cross Society in Bangkok. Dogs that had bitten one or more persons and were stray, unwanted, or died during the period of observation were submitted for pathologic examination. Approximately 30 percent of dog brains submitted for pathologic analysis over the next several months were confirmed to have rabies. An investigation by the office revealed that few people sought medical attention for dog bites. The office began an extensive community education effort emphasizing the importance of post-exposure immunization. In October 1987, only four people were seen for treatment of dog bites. Beginning in November, the number of visits increased to approximately 30 per month and stayed at that level.

The Health Information Office also conducted a community survey to assess the dog population in the camp. It was determined that the dog population was comprised of mostly pet animals. Less than 20 percent of bites were traced to stray dogs, justifying an animal vaccination campaign. In the year following this campaign, none of the suspect dogs submitted for pathologic examination were found to have rabies.

Hospital Discharge Data

The vast majority of pediatric admissions were for acute infectious diseases: acute respiratory illness, skin infections, otitis media, and diarrheal disease (Table 2). Continuous monitoring of hospital discharge diagnoses provided definition of the seasonal variation of infectious diseases in the camp. Acute respiratory illness and diarrheal disease were most common in the rainy season (June—September). Skin infections were common throughout the year.

Monitoring of hospital discharge diagnoses also facilitated the early identification of outbreaks of these common pediatric illnesses. For example, there was an outbreak of acute respiratory illness in August and September. At the peak of the epidemic, the outpatient clinics, in Site 2 South saw 1,361 cases of pneumonia in a 17-day period. Most cases

TABLE 2—Hospital Discharge Diagnoses—June 1987 to May 1988

Diagnosis	Hospitalization Rate* Cases per 1,000 per year	Proportional** Morbidity (%)
Children (<15 years)		
Acute Respiratory Illness***	45.22 (1445)	34.3
Skin Infections	28.91 (924)	21.9
Otitis Media	9.33 (298)	7.1
Diarrheal Disease	8.58 (274)	6.5
Other	41.01 (1276)	30.3
Adults		
Prolonged Fever	94.27 (3623)	55.1
Skin infection	22.43 (862)	13.1
Falciparum Malaria	7.49 (288)	4.4
Urinary Tract Infection	6.45 (248)	3.8
Other	40.32 (1551)	23.6

*Number of cases in parentheses.
**Percent of hospitalized cases.
***Predominantly pneumonia, bronchiolitis, and croup.

occurred in infants or young children. Clinically, these children had diffuse pulmonary rales, with occasional wheezing. Chest X-rays performed in severe cases revealed diffuse interstitial pneumonia. A viral etiology was presumed on the basis of this information. Antibiotics were used conservatively and children were carefully observed for signs of hypoxia.

A large outbreak of diarrhea was seen in December and January. Almost all cases occurred in children under two years of age, with 56 percent of the cases occurring in infants. A spot map of cases failed to reveal any specific foci of infection. Chlorine levels in the water supply were found to be adequate to prevent microbiologic contamination. Clinically, children were afebrile and had watery, non-bloody diarrhea. This was presumed to be a rotaviral outbreak and efforts focused on the education of mothers in the preparation and use of oral rehydration therapy.

The majority of adult hospital admissions were also for acute infectious diseases. The most common diagnoses were "prolonged fever," skin infections, falciparum malaria, and urinary tract infections (Table 2). The term "prolonged fever" designates a collection of infectious diseases that are not easily distinguished with the diagnostic facilities available at Site 2. It is applied when the patient has 48 hours of documented fever >38.5 C, three negative malaria smears, and no signs or symptoms suggesting localized infection. Occasionally the clinical presentation is precise enough to allow a specific diagnosis, such as scrub typhus or typhoid fever, to be made. More often the patient is treated empirically and the discharge diagnosis is simply "fever of unknown origin." Analysis of the monthly discharge diagnoses of "scrub typhus" and "fever of unknown origin," however, showed an inverse relationship, suggesting considerable variation in the convention used for assigning these diagnoses.

There was no clear seasonal variation in the incidence of prolonged fever, skin infections, or urinary tract infections. Falciparum malaria occurred principally in November through January. These are the months following the rainy season during which men leave the camp to resume fighting in Cambodia.

Discussion

The demographic indicators in Site 2 South reveal some of the anomalies of long-term refugee camps. The crude birth rate is very high and comparable to that seen in the least developed countries.[19] On the other hand, the crude death rate is extremely low; lower than even in the most developed countries. (For comparison the US crude death rate is 9.) This reflects an age distribution skewed toward the very young and possibly the ready access to effective health services. Furthermore, the residents of long-term refugee camps are survivors. The more vulnerable members of a refugee population often perish during forced migration or the emergency phase of a relief effort.

The estimated infant and under-five mortality rates are middle range and comparable to those seen in countries such as Korea and Panama.[19] They were lower than the figures reported for Thailand (infant mortality rate = 41, under-five mortality rate = 53), despite the fact that the level of health care in Site 2 is designed to be comparable to that available in surrounding Thai communities. The geographic localization of the population, the greater intensity of health services, and the absence of financial barriers make this care much more accessible, however.

The ability to accurately characterize the demographics of a refugee population is important for optimal planning of humanitarian assistance efforts. For example, the high birth rate and low death rate in Site 2 indicate that, even without new arrivals, the population will expand at over 4 percent a year. Given the already overcrowded conditions in the camp, and the ill effects of this overcrowding on physical and mental hygiene, long-range planning must include identifying more land on which to shelter this population. These data also underscore the need for effective family planning efforts as part of an overall program for maternal and child health. Analysis of mortality trends can identify vulnerable subpopulations and indicate specific diseases requiring control or surveillance.

The importance of maintaining a reportable disease system that can readily identify outbreaks of illness requiring immediate public health intervention is essential in the overcrowded environment of a refugee camp. This is well illustrated by the Health Information Office's experience with the 1987 dengue hemorrhagic fever outbreak. While it is impossible to know what the course of this outbreak would have been without intervention, the large number of cases seen in nearby urban areas of Thailand, where disease control efforts were more difficult to implement, suggests the office's activities may have averted a much larger outbreak.[18] The experience of the Health Information Office in confronting rabies in the dog population of Site 2 demonstrates the role of such an office in coordinating a community response to a serious public health threat.

The successful provision of health services in a long-term refugee camp requires a strong community orientation. The training of refugee health providers and the briefing of expatriate health professionals must emphasize the public health context within which patients develop illness. The use of simple methods of epidemiologic surveillance and investigation can greatly facilitate the development of this perspective by documenting geographic, seasonal, and epidemic patterns of disease in the community. In an environment lacking the facilities for laboratory confirmation, therapy is often administered empirically based on the clinician's "best guess" as to the likely etiology. Consequently, clinicians aware of the epidemiologic patterns of disease in the community are better equipped to provide optimal care to the individual patient. The regular monitoring of hospital and outpatient discharge diagnoses by the Health Information Office allowed prompt characterization of disease outbreaks, as well as long-term or seasonal trends.

There has been little experience with epidemiologic investigation of non-infectious diseases in the camp. Occasionally outbreaks of illness have been traced to toxic ingestion of plants or black market medications. Recently, monitoring of hospital discharge data led to the recognition of a steady increase in the number of patients with trauma. Further investigation revealed a dramatic increase in suicide and domestic violence rates, symptomatic of the growing crisis in mental health in Site 2.[20] These are late signs, however, and not adequately sensitive for surveillance activities. As experience is gained, the use of simple epidemiologic methods will be extended to surveillance and investigation of non-infectious and chronic diseases, such as hypertension and cervical cancer.

In the last several decades, the world has seen ever-growing numbers of refugees. Increasingly these refugees are becoming "long-stayers", living in subsistence camps for indefinite time periods. As the nature of refugee environments changes, the providers of assistance must mature and learn from their experiences. Unfortunately, refugee situations are often dominated by well-intentioned, but short-term, poorly prepared personnel operating in duplicative and loosely coordinated efforts.[1,3,10] Refugee health care should not be a hobby. It requires the coordinated efforts of refugee and expatriate health planners and providers sensitive to the public health needs and resource scarcities of long-term refugee camps. Our experience demonstrates that epidemiologic surveillance and investigation have an important role in shaping the clinical and public health response to infectious disease in these camps.

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Child Vaccine Injury Claim Deadline is October 1

Health and Human Services Secretary Louis W. Sullivan has issued a reminder that the deadline is October 1, 1990 for a certain class of claimants who are eligible to use the recently authorized National Vaccine Injury Compensation Program. The program, which went into effect October 1, 1988, is intended to serve as a faster and less expensive procedure than a civil suit for resolving claims for certain vaccine-related injuries. Using this no-fault system, petitioners do not need to prove that those who manufactured or administered the vaccine were at fault. They must prove only that the vaccine is related to the injury. The federal program provides compensation to individuals who suffered injuries associated with one of the following vaccines: diphtheria and tetanus toxoids and pertussis vaccine (DTP); measles, mumps and rubella vaccine; oral polio vaccine; inactivated polio vaccine.

For injuries that occurred before October 1, 1988, claimants must file by October 1 of this year to use this program. Although claimants may not use the program if they file later, they still may pursue their claims in civil court. For injuries occurring on or after October 1, 1988, claimants must file within certain periods prescribed by the National Childhood Vaccine Injury Act of 1986 as amended.

As of April 5, 1990, some 263 petitions have been filed, 254 of which stemmed from injuries that occurred before October 1, 1988. Sixty awards totaling $31.5 million had been made as of April 5 under this program, with amounts ranging from $86,000 to $2.8 million.

For persons seeking information on the National Vaccine Injury Compensation Program, the Health Resources and Services Administration (HRSA) operates a toll-free hotline. The number is 800/338-2382.

Physician Breach of Patient Confidentiality among Individuals with Human Immunodeficiency Virus (HIV) Infection: Patterns of Decision

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6T

Abstract: To determine whether the sex, race, or sexual preference of a patient infected with immunodeficiency virus (HIV) influences a physician's decision to breach patient confidentiality, Tennessee primary care physicians were mailed a questionnaire containing a case study in which an HIV-infected patient presented a risk to a third party. Eight different descriptions of the sex, race, and sexual preference of the hypothetical patient were distributed randomly among the physicians, one description to each physician. The physicians were asked to decide whether to maintain confidentiality, notify the health department, or inform the patient's partner. Responses of 199 White male physicians were analyzed using an unconditional saturated logistic regression model. The odds ratios for these physicians saying they would send the patient's antibody status to the health department extend from 18.4 (95 percent confidence interval: 1.3, 260.1) for Black homosexual males to .5 (95 percent CI: 0, 11.5) for White homosexual females. The odds ratios for White male physicians saying they would inform the patient's partner range from 7.5 (95 percent CI: .8, 69.2) for Black heterosexual males to 1.0 (reference category) for Black homosexual females. The results suggest that when physicians decide to protect a third party by breaching an HIV-infected patient's confidentiality, their decision may be influenced in some cases by the race, sex, and sexual preference of the patient. (*Am J Public Health* 1990; 80:829–834.)

Introduction

One of the perceived ethical dilemmas associated with the acquired immunodeficiency syndrome (AIDS) epidemic is whether a physician should breach the confidentiality of a patient infected with the human immunodeficiency virus (HIV) to inform a third party at risk of infection from the patient but unaware of that risk. The American Medical Association has recommended that "if persuasion fails, the authorities should be notified; and if the authorities take no action, the physician should notify and counsel the endangered third party."[1] In this statement and similar statements[2,3] and discussions[4,5] of the policy of third-party protection, the assumption is that the demographic characteristics or sexual preference of the patient and third party are not relevant and that implementation of the policy is independent of the patient's identity. Kelly, *et al*,[6,7] have shown that AIDS patients are stigmatized by physicians. Because the policy of third-party protection requires that the physician judge the degree of danger presented by an HIV-infected patient to a third party and because that judgment could be influenced by social factors, we extended the work of Kelly, *et al*.[6,7] The purpose of our research was to evaluate the effect of a patient's demographic characteristics and sexual preference on a physician's decision to breach an HIV-infected patient's confidentiality to protect a third party.

Methods

Sample

A stratified random sample of 628 practicing primary care physicians was identified[8] from a population of 2,804 primary care physicians practicing in Tennessee in 1986. The strata used were specialty (family practice, general practice, obstetrics and gynecology, or internal medicine) and size of the community in which the physician practiced (urban or rural). Randomization was successful so that the distributions by specialty and community size observed in the sample were similar to those observed in the population. Both the sample and the population consisted of approximately 27 percent family practitioners, 15 percent general practitioners, 20 percent obstetricians and gynecologists, and 40 percent internal medicine specialists. Rural physicians constituted approximately one-third of both of the sample and the population. Each physician in the sample was mailed a questionnaire, with instructions to respond anonymously. To improve the response rate, a second questionnaire was sent to the entire sample, with instructions to ignore the second mailing if the first questionnaire had been returned. The combined response rate to the two mailings was 37.1 percent (233 questionnaires returned). Besides sending questionnaires, further efforts to contact individual nonrespondents could not be made due to the anonymity of the respondents.

Questionnaire

The questionnaire elicited information about the physician's demographic characteristics, knowledge of HIV infection and AIDS, and attitudes toward individuals infected with HIV. One of eight variations of the following description of a hypothetical patient, based on the work of Kelly, *et al*,[6,7] was presented to each physician: "John (Joan) is a 30-year-old Black (White) heterosexual (homosexual) male (female) who tested positive for HIV by the ELISA antibodies test and confirmed by the Western Blot test. He (she) has not been getting along with his (her) partner. He (she) has asked you not to tell her (him, i.e., the partner) the results of the test because he (she) believes that the knowledge would complicate matters." The subject was described as one of the eight possible combinations of sex, race, and sexual preference (for example: Black homosexual female) until the eight possible combinations of sex, race, and sexual preference were exhausted. The eight vignettes, identical except for the description of the hypothetical patient, were distributed randomly among the 628 physicians. The algorithm for randomization was the same for the first and second mailings so that each physician received a second questionnaire with a description of the same hypothetical patient as was in the first. Each of the eight vignettes was followed by these progressively intrusive five statements (the first of the five

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statements was intended to infringe on the patient's privacy the least and the last statement the most):

1. The knowledge of the antibody status would remain between my patient and me.
2. I would attempt to persuade the patient to inform any partners who might be infected.
3. The antibody status, but not the name, would be reported to the health department.
4. The name of the person and the antibody status would be reported to the health department.
5. If the person would not inform any partners who might be infected, I would attempt to do so if the person identified them.

Physicians were asked to indicate which of these statements would characterize their actions. More than one selection was permitted.

Analysis

Of the 233 respondents to the questionnaire, 11 were not considered for the analysis because they did not report the action they would take. If a physician indicated more than one decision, the decision that most violated the patient's privacy was used as a dependent variable in the analysis. The responses of the three physicians who said that the knowledge of the patient's antibody status would remain confidential were combined with the responses of the 53 physicians who said they would try to persuade the patients to inform their partners. We used unconditional logistic regression[9] to compare the hypothetical patients' characteristics among the physicians' decisions. The dependent variable for three separate models was coded "0" if the physician would maintain patient confidentiality or persuade the patient to inform his or her partner. The dependent variable was coded "1" in these three situations: (1) if the physician would notify the health department of the patient's antibody status (the first model) or (2) if the physician would provide the health department with the patient's antibody status and name (the second model) or (3) if the physician would inform the patient's partner (the third model). The independent variables were the hypothetical patients' sex, race, and sexual preference. Also included in each model were the potentially confounding variables: physician age, year of graduation from medical school, physician specialty, and the urban or rural location of each physician's practice. The change in estimate criteria[10] was used to decide whether to retain the confounding variables in the final models.

In a second set of three logistic regression models, the independent variables were represented by seven dummy variables corresponding to seven of the eight combinations of sex, race, and sexual preference of the hypothetical patients. The category of Black homosexual female was used as a reference category and therefore not represented by a dummy variable. The category of Black homosexual female was selected as a reference because doing so made most of the odds ratios positive and therefore easier to interpret. These three regression models were also adjusted for confounding using the change in estimate criteria.[10]

In addition to including confounding variables in the regression models, confounding was addressed by assigning the descriptions of the hypothetical patients at random and by restriction of the regression analysis to White male physicians. The prevalence odds ratios presented in this paper are based on a cross-sectional survey and are therefore not estimates of relative risks.

Finally, to determine whether the physician's age, year of graduation from medical school, specialty, residence, knowledge of HIV infection and AIDS, and attitude toward individuals with AIDS modified the effect of race on the ethical decision, we used logistic regression models containing race-physician characteristic interaction terms.

Results

The distribution by specialty and location of practice of the 222 responding physicians (Table 1) was similar to that of the 628 physicians in the sample. Because half the questionnaires sent to the physicians described White hypothetical patients, half described Black, half described homosexuals, and so on, lack of response bias would be suggested by the return of questionnaires in the proportions in which they were sent. Of the returned questionnaires, 50 percent described female patients, 49.1 percent described Black patients, and 49.6 percent described homosexual patients. Further, each of the eight patient descriptions constituted approximately 12.5 percent of the sample of the returned questionnaires. To eliminate the physician's sex and race as sources of confounding, the subsequent analysis was confined to the 199 White male physicians in the sample.

Table 2 shows the physicians' characteristics associated with each type of hypothetical patient. While the relatively small numbers of observations in each category show some variation, there appear to be no systematic patterns of association. Similarly, Table 3 illustrates an unexpected consistency of physician age across the different decisions.

The unadjusted percentages of decisions for each type of hypothetical patient are shown in Table 4. The range of the percentage of physicians who said they would maintain the patient's confidentiality varies from only 8.7 percent for Black heterosexual males to 44.4 percent for Black homosexual females. Black males and Black heterosexual females were each associated with a relatively high percentage of physicians who said they would report their antibody status to the health department (17.4, 21.4, and 17.4 percent Black

TABLE 1—Distribution of the Characteristics of the 222 Responding Physicians

Variables	Percentage in Each Category
Age (years)	
21–30	0.5
31–40	31.5
41–50	21.2
51–60	20.3
60+	27.0
Race and Sex	
Black female	0.5
White female	6.8
Black male	3.2
White male	89.6
Specialty	
Family practice	27.9
General practice	11.7
Obstetrics and gynecology	20.7
Internal medicine	36.5
Missing	3.0
Community	
Rural	33.8
Memphis	19.8
Nashville	20.3
Chattanooga	11.3
Knoxville	14.9

TABLE 2—Percentage Distribution of Potentially Confounding and Effect-modifying Variables for the Categories of the Hypothetical Patients

Physicians' Characteristics	Black Homosexual Female (*n* = 18)	Black Homosexual Male (*n* = 28)	Black Heterosexual Female (*n* = 23)	Black Heterosexual Male (*n* = 23)	White Homosexual Female (*n* = 30)	White Homosexual Male (*n* = 24)	White Heterosexual Female (*n* = 27)	White Heterosexual Male (*n* = 26)
Age (years)								
21–40	5.6	28.6	56.5	30.4	33.3	37.5	37.0	15.4
41–60	50.0	42.9	26.0	30.4	46.7	29.2	37.0	61.4
61+	44.4	28.6	17.4	39.1	20.0	33.3	25.9	23.1
Year MD degree received (median)	1954	1960	1972	1968	1968	1963	1959	1960
Specialty[a]								
Family practice	27.8	10.7	26.1	39.1	26.7	33.3	37.0	34.6
General practice	22.2	17.9	8.7	17.4	10.0	4.2	18.5	7.7
Obstetrics and gynecology	11.1	17.9	21.7	21.7	20.0	16.7	18.5	26.9
Internal medicine	38.8	46.4	40.1	21.7	33.3	37.5	44.4	26.9
Community								
Rural	22.2	21.4	21.7	8.7	23.3	12.5	11.1	26.9
Urban	77.8	78.6	78.3	91.3	76.7	87.5	88.9	73.1

a) Percentages do not always add to 100% because 7 missing values are not shown.

TABLE 3—Percentage of Physicians' Decisions by Categories of Potentially Confounding and Effect-modifying Variables

Physicians' Characteristics	Would Maintain Confidentiality (*n* =56)	Would Report Antibody Status to Health Department (*n* = 21)	Would Report Name to the Health Department (*n* = 78)	Would Inform Patient's Partner (*n* = 44)
Age (years)				
21–40	30.4	33.4	32.1	29.5
40–60	35.7	38.1	42.3	45.5
60+	33.9	28.6	25.6	25.0
Year MD degree received (median)	1963	1959	1964	1961
Specialty[a]				
Family practice	23.2	38.1	25.6	38.6
General practice	16.1	9.5	9.0	18.2
Obstetrics and gynecology	21.4	9.5	26.9	9.1
Internal medicine	33.9	28.6	34.6	34.1
Community				
Rural	17.9	9.5	21.8	18.2
Urban	82.1	90.5	78.2	81.8

a) Percentages do not always add to 100% because 7 missing values are not shown.

TABLE 4—Percentage Distribution of Patient's Category among the Physicians' Decisions

Patient Category	Would Maintain Confidentiality		Would Report Antibody Status		Would Report Name		Would Inform Patient's Partner		Total
	n	%	*n*	%	*n*	%	*n*	%	(100%)
Black homosexual female	8	(44.4)	1	(5.6)	6	(33.3)	3	(16.7)	18
Black homosexual male	7	(25.0)	6	(21.4)	8	(28.6)	7	(25.0)	28
Black heterosexual female	7	(30.4)	4	(17.4)	8	(34.8)	4	(17.4)	23
Black heterosexual male	2	(8.7)	4	(17.4)	12	(52.2)	5	(21.7)	23
White homosexual female	10	(33.3)	1	(3.3)	15	(50.0)	4	(13.3)	30
White homosexual male	7	(29.2)	2	(8.3)	7	(29.2)	8	(33.3)	24
White heterosexual female	8	(29.6)	2	(7.4)	11	(40.7)	6	(22.2)	27
White heterosexual male	7	(26.9)	1	(3.9)	11	(42.3)	7	(26.9)	26
Total (%)	56	(28.1)	21	(10.6)	78	(39.2)	44	(22.1)	199

heterosexual males, Black homosexual males, and Black heterosexual females, respectively). Physicians said they would directly inform the partners of White homosexual males more often than they would individuals in other categories. The overall association between the hypothetical patients' characteristics and the physicians' decisions was not statistically significant ($\chi^2[21] = 20.2$, $p = .51$). Because the data were sparse, a Monte Carlo estimate of the exact *p*-value was run.[11] The estimated *p*-value was identical to the large sample *p*-value.

The ratios odds shown in Table 5 represent the results of three separate logistic regression models. In each of these models, physicians who said they would maintain the patient's confidentiality are compared to those who made one of the other three decisions shown in the column headings in Table 5. The odds for physicians saying they would send the antibody status of Blacks to the health department are 10.7 times (95 percent CI: 2.2, 52.0) those for saying they would send the antibody status of Whites. Males, Blacks, and heterosexuals have odds ratios greater than 1.0 for each of the three comparisons.

TABLE 5—Influence of Hypothetical Patient Category on White Male Physician's Decisions

	Would Report Antibody Status		Would Report Name		Would Inform Patient's Partner	
Patient Category	Odds Ratio	(95% CI) (n = 77)[a]	Odds Ratio	(95% CI) (n = 134)	Odds Ratio	(95% CI) (n = 100)[b]
Male	2.0	(.5, 7.3)	2.6	(.9, 8.0)	2.8	(1.2, 6.8)
Female	1.0		1.0		1.0	
Black	10.7	(2.2, 52.0)	3.6	(1.2, 11.0)	1.3	(.5, 3.1)
White	1.0		1.0		1.0	
Heterosexual	1.5	(.4, 5.9)	1.9	(.6, 5.7)	1.2	(.5, 2.9)
Homosexual	1.0		1.0		1.0	

a) Adjusted for physician speciality, year of graduation from medical school, and location of practice. Four missing values for specialty excluded from the analysis.
b) Adjusted for physician specialty. Three missing values for specialty excluded from the analysis.

To see if the average effects (e.g., Black) shown in Table 5 were masking the modifying effects of the patient's sex, race, and sexual preference on one another, we ran a second set of regression equations using dummy variables to represent seven of the eight categories of patient sex, race, and sexual preference (Table 6). The category Black homosexual female was selected as the reference category because of the high percentage of physicians who said they would maintain confidentiality in this category (44.4 percent, Table 4). Using Black homosexual females as a reference category made most of the odds ratios greater than 1.0 (Table 6). The odds of White male physicians saying they would report the antibody status of Black homosexual males, as opposed to maintaining their confidentiality, were 18.4 times (95 percent CI: 1.3, 260.1) those of saying they would report the antibody status of Black homosexual females (Table 5). Considering the small sample size, the magnitude of the odds ratios (OR) for reporting the antibody status for Black heterosexual males (OR 10.7, 95 percent CI: .7, 192.4) and Black heterosexual females (OR 9.3, 95 percent CI: .7, 132.1) should also be noted. When the patient was described as a Black heterosexual male, the odds of physicians saying they would report a patient's name to the health department (OR 8.0, 95 percent CI: 1.3, 50.0) or inform a patient's partner (OR 7.5, 95 percent CI: .8, 69.2) were highest. The odds of informing the partners of White homosexual males were 4.8 (95 percent CI: .7, 30.8) times the odds of informing the partners of Black homosexual females.

The analysis of the modifying effects of the physicians' characteristics on the race of the patient showed that family practitioners said they would send the names of Blacks (OR 19.1, 95 percent CI: 2.5, 143.9) to the health department more often than they would send the names of Whites (OR 1.0, reference). None of the other patient characteristics that we examined (e.g., age, location of practice, knowledge of AIDS) appeared to modify the influence of the patient's race on the physicians' decisions.

If the physician indicated more than one decision, preceding analyses used the physician's decision that most infringed on the patient's privacy as the dependent variable. To determine whether the patient's characteristics influenced the progression of the physicians' decisions from less to more intrusive, we compared the responses in which physicians indicated more than one decision (n = 120) with those in which physicians indicated they would directly report the patient (n = 23). Physicians more often said they would attempt to persuade women to inform their partners before intruding on their privacy (OR 2.5, 95 percent CI: .9,6.8) than they would men (OR 1.0, reference).

We could not evaluate the importance of the characteristics of the hypothetical partner in predicting the physicians' decisions because the assumed characteristics of the partner were highly correlated with the sex-sexual preference interaction term; models including both the characteristics of the patient and of the hypothesized partner could not be estimated. Those models including the characteristics of the partner only yielded results similar to those containing the characteristics of the patient. Because the sex, race, and sexual preference of the hypothetical partner were not known and those of the hypothetical patient were, we modeled only the patient characteristics.

To estimate the degree to which being a White male (relative to being a Black male) would influence physicians' underreporting of HIV-infected patients to the health department, we calculated the population attributable risk.[9] We defined the outcome of interest as not being reported to the health department; we defined the exposure as being a White male. Using the data in Table 4, the estimated cumulative incidence of physicians saying they would not report White

TABLE 6—Influence of Hypothetical Patient Category on White Male Physicians' Decisions

	Would Report Antibody Status		Would Report Name		Would Inform Partner	
Patient Category	Odds Ratio	(95% CI) (n = 77)[a]	Odds Ratio	(95% CI) (n = 134)	Odds Ratio	(95% CI) (n = 100)[a]
Black homosexual female	1.0	(Reference)	1.0	(Reference)	1.0	(Reference)
Black homosexual male	18.4	(1.3, 260.1)	1.5	(.4, 6.6)	4.2	(.7, 27.1)
Black heterosexual female	9.3	(.7, 132.1)	1.5	(.4, 6.6)	2.1	(.3, 15.6)
Black heterosexual male	10.7	(.7, 192.4)	8.0	(1.3, 50.0)	7.5	(.8, 69.2)
White homosexual female	.5	(.0, 11.5)	2.0	(.5, 3.8)	1.1	(.2, 5.7)
White homosexual male	.9	(.0, 20.1)	1.3	(.3, 5.9)	4.8	(.7, 30.8)
White heterosexual female	2.3	(.2, 35.2)	1.8	(.5, 4.0)	1.7	(.3, 2.3)
White heterosexual male	.7	(.0, 14.8)	2.1	(.5, 4.1)	2.3	(.5, 11.5)

a) Adjusted for physician specialty, 7 missing values excluded from the analysis. See footnote Table 5.

males to the health department was .40. The cumulative incidence of saying they would not report Black males to the health department was .23. If 33 percent of HIV-infected males are White,[12] then the percentage of HIV-infected males who would not be reported to the health-department because they are White is 20 percent.

Discussion

White male physicians' decisions to violate patient confidentiality to protect a third party were influenced in some cases by the race, sex, and sexual preference of a hypothetical patient. Presented with vignettes about hypothetical patients, these physicians said they would report Black homosexual and heterosexual men to the health department and Black heterosexual men to their partners more often than they would report hypothetical patients in the other categories. Black heterosexual women and homosexual men were also less likely to have their confidentiality maintained. Family practitioners said they would report the antibody status of Blacks to the health department more often than would practitioners in other specialties.

Although the response rate is low, the internal validity of the survey has not been compromised and may be better than it would have been had the survey not been anonymous. As noted in the results section, the questionnaires were returned in proportion to their distribution in the sample. As Greenland[13] points out, the equality of the proportion responding over the levels of the exposure variable is not sufficient to assure lack of response bias. Response bias could have occurred in this case if the physicians who would have said they would breach confidentiality had been more or less likely to have responded, depending on the description of the hypothetical patient they received. Since the description of the scenario occurred on the sixth page of the questionnaire, it is unlikely that the physician decision to return to the questionnaire depended on the characteristics of the hypothetical patient and even less likely that there were interactions among the decision to return the questionnaire, the characteristics of the hypothetical patient, and the physician response.

Another component of internal validity is information bias. It was to prevent information bias that the anonymous questionnaire was chosen, since we believed that questions about physician knowledge and ethical decisions could best be answered anonymously. This is the method used by Kelly, *et al*,[7] and we achieved a higher response rate than they did. While the proportion responding is an important criterion, the validity of a study should not be sacrificed merely to achieve a high response rate.

That the study is externally valid is suggested by the equality of the distribution of physician specialty and location of practice among the respondents to that of the sample. However, the respondents may differ from those who did not respond in ways that cannot be measured; what is important is that whoever these 222 respondents represent, some appear to be influenced by the sex, race, and sexual preference of the hypothetical patients when making an ethical decision. Even if the nonrespondents were completely impartial, the respondents constitute a large enough portion of the total sample to require consideration.

The fallacy of using statistical significance alone as a criterion for interpreting the results of observational studies has been discussed at length in this Journal.[14–18] Although there can be no question of the statistical significance of the odds ratios associated with Black homosexual and heterosexual males, one might question whether the borderline associations in the first and third column of Table 6 (having confidence intervals with lower bounds greater than or equal to .7 and less than 1.0) are meaningful. First, the borderline confidence intervals must be interpreted in the context of small sample sizes, multicollinearity, and the pattern of the odds ratios across the levels of the physician decisions. Of the five borderline confidence intervals, four are associated with a hypothetical patient who is Black. Because of the artifacts working against statistical significance, it would be improper to dismiss the borderline associations as uninformative. Most important, our results are consistent with the known stigmatization of Blacks,[19] more specifically of Black men, by Whites. It is in this context that our findings must be given serious consideration.

Whether the results can be attributed to prejudice or whether the different physician response patterns were motivated by consideration of the sources of HIV infection prevalent in the groups with which the hypothetical patients were associated cannot be determined from these data. Because Blacks who are infected with HIV are more likely to use intravenous drugs than are similarly infected Whites,[12] physicians may believe that they are less likely to be conscientious about informing their partners. Blacks are more often treated in the health department than are Whites[12]; therefore physicians who say they would send Blacks to the health department may merely reflect sociological reality rather than exhibit prejudice. However, saying they would send Black men to the health department more often than hypothetical patients in other categories is also consistent with racial prejudice.

Laumann *et al*,[20] found evidence for the underreporting of AIDS among middle class Whites. They suggest that the underreporting may be due, in part, to the diagnosis of Whites by private physicians, while Blacks are more often diagnosed by individuals directly associated with the health department. Our results are consistent with Laumann's findings and suggest one pathway for the underreporting of Whites. If accurate estimates of the number of individuals infected with HIV or diagnosed with AIDS are to be made, physicians should be made aware of this possibly unconscious bias in reporting.

Further research is needed to determine whether the observed patterns can be attributed to risk factors that are more prevalent among HIV-infected Black men (such as intravenous drug use) or with racial prejudice or both. Regional patterns of physician decision-making should be investigated, and the characteristics of physicians who make particular types of decisions should be identified. Because physicians may not be aware that their HIV-related ethical decisions are influenced by the characteristics of the patients, the results of such research can, in themselves, be educational and may also explain some of the patterns of underreporting of HIV-infected individuals.

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US Organ Transplant System Called 'Effective and Efficient'

The United States now has a "defined organ transplantation system, operated through the Organ Procurement and Transplantation Network, that appears to be effective and efficient," stated Dr. Robert G. Harmon, Health Resources and Services Administration (HRSA) Administrator, in testimony on April 20 before Rep. Henry Waxman's Subcommittee on Health, US House of Representatives.

The OPTN is operated by the United Network for Organ Sharing in Richmond, Virginia which has received HRSA contract funds since 1986 for its development and operation. All clinical transplant centers, organ procurement organizations, and tissue typing laboratories involved in organ transplantation are participating members of the network. Dr. Harmon cited a number of "significant accomplishments" made during the developmental period:

- The number of multi-organ donors increased by 30 percent since 1985, from 2,120 to 2,753 a year;
- The donor kidney discard rate decreased from 12.5 percent in 1986 to the present 4.6 percent;
- The number of kidneys exported overseas decreased by 93 percent, from 258 in 1983 to 17 in 1989, making more kidneys available to patients in the United States;
- A single source of data on organ donors, transplant candidates and transplant recipients has been established; and
- Procedures are in place to develop policies designed to assure equitable access to donate organs.

The number of heart and liver transplants and transplant centers has grown rapidly in recent years. From 1984 to 1989:

- Liver transplants rose from 308 to 2,160;
- Heart transplants rose from 346 to 1,673; and
- Pancreas transplants rose from 87 to 413.

The number of transplant programs also rose markedly. From 1984 to 1989:

- Heart programs increased from 37 to 147;
- Liver programs increased from 24 to 79; and
- Kidney programs increased from 170 to 221.

Despite the growing number of transplants, the number of people waiting for donor organs continues to increase. Currently more than 20,000 people are waiting for an organ transplant. The number of donors decreased from 4,090 in 1988 to 3,993 in 1989.

More information is available from the Division of Organ Transplantation, Bureau of Maternal and Child Health and Resources Development, Room 11A-22, HRSA, 5600 Fishers Lane, Rockville, MD 20857. Tel: 301/443-7577.

Effect of Changing Patterns of Care and Duration of Survival on the Cost of Treating the Acquired Immunodeficiency Syndrome (AIDS)

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and Arnold M. Epstein, MD, MA

Abstract: We performed a two-year cost of illness study of 240 AIDS patients (55 percent of all Massachusetts cases) diagnosed and treated at five hospitals from March 1984 through February 1986. Sociodemographic and clinical data as well as information on medical utilization were obtained from review of inpatient and outpatient hospital records.

The yearly inpatient cost per patient decreased by 28 percent from $38,369 in year one to $27,714 in year two. These changes were related to shorter lengths of stay (from 20.6 days to 16.8 days per hospitalization, mean difference of 3.8 days, 95% CI of the difference −.2, 7.8), and less costly hospitalizations (from $12,463 to $9,957, mean difference of $2,506, 95% CI of the difference $135, $4,877). The probability of hospitalization, however, was similar in both years. These patterns of care were still evident after controlling for transmisson category, race, site, mortality, insurance, age, gender, number and type of opportunistic diseases and time since diagnosis. Although the cost per patient per year decreased between years one and two, median survival increased by 70 percent (from 10 to 17 months). Hence overall estimated lifetime costs increased by 24 percent. (*Am J Public Health* 1990; 80:835–839.)

Introduction

As of December 1989, more than 100,000 cases of AIDS (acquired immunodeficiency syndrome) had been reported to the Centers for Disease Control (CDC).[1] It is estimated that there may be an additional 1.5 million people infected with the human immunodeficiency virus (HIV),[2] the virus that causes AIDS.[3-5] The CDC has projected that in the next three years, the number of AIDS patients may increase more than four-fold.[6]

Several studies examining the medical costs of treating AIDS have been performed, with lifetime medical care cost estimates ranging from $20,320 to $147,000 per patient.[7-16] Although these studies provide useful preliminary information, they suffer from a variety of deficiencies. Almost all of the studies to date have been based at single settings with small numbers of patients or have used the records of a single insurer. They have generally examined cross-sectional data over limited periods of time, hence were unable to measure changes in utilization over time. Temporal changes are important because medical and social treatment patterns may vary substantially for a newly discovered disease. In addition, previous studies have generally not included survival data which makes it difficult to estimate lifetime costs and have not provided information on the costs of treatment in relation to clinical characteristics.

This report describes a two-year study designed to address these issues. It includes data describing patterns of inpatient and outpatient medical utilization, survival and cost for patients with AIDS as well as changes in these patterns over the two-year period.

Methods

Selection of Patients

Study participants were selected by reviewing medical records at five major Massachusetts medical centers that care for patients with AIDS. Four Boston hospitals were selected because they provided care for the largest number of AIDS cases in Massachusetts; the fifth was selected because it had cared for the largest number of cases in the state outside of Boston. All persons receiving primary care for AIDS at one of the five study hospitals between March 1, 1984 and February 28, 1986, and who met the CDC criteria for AIDS[17] were included. Patients who met the 1986 CDC criteria for AIDS and did not receive their primary care at these institutions (those seen once for consult or only for therapeutic protocols) were excluded. The protocol for this study was approved by the Institutional Review Boards at all participating institutions.

A total of 240 cases were identified by the five medical centers, including 34 prevalent cases identified at the beginning (3/1/84) of the observation period and an additional 206 cases diagnosed during the two-year observation period. To assess completeness of patient identification, names of the study participants were phonetically coded by use of a Soundex code and compared with statewide AIDS surveillance records. The 206 incident cases represented 87 percent of the 236 cases that were diagnosed and reported to the AIDS surveillance program by the same hospitals and 55 percent of all AIDS patients reported to the state program during the two-year observation period. Due to concerns of confidentiality, we were not able to ask hospitals for records of the 30 patients that were discovered as having been reported to the surveillance program but not identified for this study. Hence we are unable to ensure that these 30 individuals were appropriate exclusions, i.e., diagnosed at the study site but recipients of primary care elsewhere. These 30 cases were similar in age, gender, transmission category, and presenting diagnosis to the 240 study subjects. Of the 240 cases, six cases (2.5 percent) were reported by more than one hospital and were credited for purposes of this study to the hospital in which the majority of utilization occurred; however, utilization from both hospitals was included in calculating overall costs.

Data Collection

Sociodemographic data (age, gender, insurance coverage, race) and clinical characteristics (opportunistic infection present at initial diagnosis, number of opportunistic infections developed during the study period, and risk factors for

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AIDS) were obtained by reviewing ambulatory and inpatient hospital records at the participating institutions. Use of outpatient services including office visits and diagnostic tests was evaluated by reviewing outpatient medical records at four of the participating institutions during the two year study period (March 1, 1984 to February 28, 1986). Because of administrative difficulties, the fifth institution, which cared for 23 percent of the study cohort, was able to provide data on outpatient utilization only for the first year of the study. Thus the denominator was reduced for calculations of outpatient utilization during the second year of the study.

Data on hospital utilization in terms of length of stay (LOS) and hospital charges were obtained from the billing departments of the participating institutions. Hospital costs were then estimated by applying the Massachusetts Rate Setting Commission year-specific/hospital-specific charge/cost ratios. Total inpatient costs per patient were derived by adding to hospital costs inpatient physician fees estimated using the following algorithim: 1) first inpatient day consisted of one admission visit, one consult visit, and one routine visit; 2) for each subsequent day, one routine visit fee was added.

Costs for ambulatory care and hospital doctor visits were estimated by using 1984 Blue Cross and Blue Shield customary reimbursement rates for office visits and diagnostic tests at hospital settings.

Data Analysis

Calculating Overall Cost—We examined cost of hospital care and ambulatory costs as well as the combined cost in terms of mean cost per patient per year during each of the two study years. Since every patient did not receive care for a full 12 months (some were diagnosed prior to the study period and some died during the study period) we tabulated a cost per patient per month for all patients alive in a particular month. For each year we calculated a mean for all patient months and multiplied by 12 to arrive at an annualized estimate.

Analyzing Incidence of Hospitalization—A two-part analysis was performed to better understand the trends and predictors of hospital admission lengths of stay and costs. We first examined overall rates of hospital admission and analyzed their association with patients' sociodemographic and clinical characteristics. Each month a subject in the study was coded as a binary variable depending on whether or not he or she was admitted to the hospital. Since more than one admission within a month was unusual (1.8 percent) and the second admission was usually related to the same episode of illness, the incidence of "hospital admission months" closely estimates the incidence of hospitalization. Crude rate ratios based on this index were calculated for study year, age, gender, transmission category (homosexual male, intravenous drug user, other), race, time since diagnosis, mortality (whether or not the patient died during the particular month), payor status, and number and type of opportunistic diseases.[18] We defined time since diagnosis as a binary variable based on whether the month was either the first or second since diagnosis, or a subsequent month. We made this determination by examining univariate plots which showed that the first two months after diagnosis were associated with a much higher incidence of hospitalization; thereafter rates were relatively similar. Next we examined the predictors of hospitalization simultaneously, estimating the likelihood of hospitalization during each month with a logistic regression model. The adjusted rate of hospitalization per month was estimated and 95% confidence intervals (CI) were calculated by the method of Miettinen.[19] For grouped variables, a likelihood ratio test of significance was performed.[20] This allowed us to assess the difference in rates of hospitalization each year for patients with the typical clinical and sociodemographic characteristics in our overall study sample. The probability of hospitalization per year was estimated from the adjusted coefficient of the maximum likelihood.[20]

Analyzing Length of Stay and Cost of Hospitalization—The second part of the analysis employed two linear regression models to examine temporal changes in the adjusted average length of stay and the average cost per hospitalization for those hospitalized. Using analysis of covariance we examined differences in cost between years one and two controlling for age, gender, transmission category, race, time since diagnosis, mortality, payor status, and the number and type of opportunistic infections.[21] As explained above, in less than 2 percent of months patients had more than one hospitalization. In order to use study "months" as our denominator we treated multiple hospitalizations during a month as a single hospitalization, combining the length of stay and costs related to the multiple events. Hence, our estimates for the likelihood of hospitalization are slightly low and our estimates for utilization and length of stay once hospitalized are slightly high. We know of no reason why this should be biased temporally. Because the distribution of the dependent variable was skewed, we performed a logarithmic transformation of length of stay and cost per hospitalization to assess statistical significance.

Survival Analysis—To determine overall cost per patient, a Kaplan-Meier survival analysis was performed on the cohort to determine the median survival.[22] A test of significance of the survival distribution comparing patients diagnosed during year one with patients diagnosed during year two was performed with the generalized Wilcoxon-Gehan Statistic.[22] Patient status (living or dead) was ascertained as of January 1, 1987 from vital records and mortality status was recorded as either dead, with the month and year of death, or alive.

To estimate lifetime costs, costs per patient month were multiplied by the median months of survival.

Evaluation of Outliers—A possible concern was the role of potential "outliers," i.e., individuals with unusually long or costly hospitalization, which may be related to temporal changes in the treatment of AIDS patients. To evaluate the potential impact of outliers, we examined the prevalence of 1 percent and 5 percent (based on the entire study population) length of stay outliers by study year. We then repeated both the length of stay and cost per hospitalization analyses with the 1 percent and 5 percent outliers removed.

Results

Table 1 displays demographic and clinical characteristics of the study cohort. The large majority were homosexual or bisexual men (81 percent); 16 percent were entirely uninsured, 24 percent had Medicare/Medicaid. Only 14 percent of patients presented with an initial diagnosis other than Pneumocystis *carinii* pneumonia (PCP) or Kaposi's Sarcoma (KS); 54 percent had multiple opportunistic diseases during the study period. There were no significant differences in demographic and clinical characteristics of individuals by year of diagnosis (Table 1).

Overall Utilization

The average length of observation was 7.6 (SD 5.3 months). Of the 240 patients with AIDS, 204 (85 percent) were hospitalized at least once during the study period. Members of the cohort were hospitalized 469 times (mean ±

TABLE 1—Demographic and Clinical Characteristics of AIDS Patients by Year of Diagnosis

Characteristics	Year 1* (n = 110) Number (%)	Year 2* (n = 130) Number (%)	Total (n = 240) Number (%)
Gender			
Male	103 (93)	120 (92)	223 (93)
Female	7 (7)	10 (8)	17 (7)
Risk Group			
Homosexual, Bisexual	88 (80)	106 (82)	194 (81)
Heterosexual/other/unknown	8 (7)	14 (11)	22 (9)
Intravenous drug use (IVDU)	9 (8)	6 (5)	15 (6)
Gay/Bisexual & IVDU	3 (2)	2 (2)	5 (2)
Blood Products	2 (2)	2 (2)	4 (2)
Insurance Status			
Blue Cross/Blue Shield	40 (36)	36 (28)	76 (32)
Public (Medicaid)	32 (29)	26 (20)	58 (24)
Commercial	17 (15)	24 (19)	41 (17)
None	13 (12)	25 (19)	38 (16)
Health maintenance organization	8 (7)	19 (15)	27 (11)
Presenting Diagnosis			
Pneumocystis carinii pneumonia (PCP)	51 (46)	63 (48)	114 (48)
Kaposi's Sarcoma (KS)	31 (28)	35 (27)	66 (28)
PCP and KS	15 (14)	12 (9)	27 (11)
Other Opportunistic infections	13 (12)	20 (15)	33 (13)
Number of Opportunistic Infections			
One	42 (38)	68 (52)	110 (46)
Two	32 (29)	32 (25)	64 (27)
Three	23 (21)	16 (12)	39 (16)
Four	13 (12)	14 (11)	27 (11)
Primary Care Hospital			
Site 1	44 (40)	55 (42)	99 (41)
Site 2	19 (17)	17 (13)	36 (15)
Site 3	7 (6)	6 (5)	13 (5)
Site 4	10 (9)	18 (14)	28 (12)
Site 5	30 (27)	34 (26)	64 (27)
Race			
White	87 (79)	96 (74)	183 (76)
Black	13 (12)	22 (17)	35 (15)
Hispanic, Other	10 (9)	12 (9)	22 (9)

*Year 1: 3/1/84–2/28/1985
Year 2: 3/1/85–2/28/1986

SD = 1.95 ± 1.8), with a mean length of stay of 17.3 (± 20.8) days (range 1–252). Mean cost per hospitalization was $10,868 (SD $12,813, Table 2).

Unadjusted medical care costs in year two were 28 percent lower than year one. Over 90 percent of these cost were related to inpatient utilization. Crude inpatient costs per patient per year were $38,369 in year one, compared with $27,714 in year two. Crude outpatient costs per patient per year were $2,706 in year one, compared with $2,215 in year two.

Rate and Predictors of Hospitalization

A stratified analysis of the rate of hospitalization showed that women, intravenous drug users (IVDU), Blacks, Hispanics, individuals who died, individuals on Medicare/Medicaid, and individuals at three of the five study sites were significantly more likely to be hospitalized. Individuals with only one opportunistic disease during the study period, or presenting with Kaposi's Sarcoma (KS) alone, were significantly less likely to be hospitalized during the study period.

When we examined age, study year, gender, risk, race, site, mortality, insurance, number and type of opportunistic diseases, initial diagnosis, and time since diagnosis simultaneously, we found that the number of opportunistic diseases, death during the study month, different categories of insurance status, time since diagnosis, and sites of care were predictors of hospitalization (Table 3).

TABLE 2—Overall Utilization during the Two-Year Study Period* (N = 240)

Description of Service	Mean ± SD	Range
No. of hospitalizations (N = 469)	1.95 ± 1.8	(0–10)
Length of Stay (days)	17.3 ± 20.8	(1–252)
No. of intensive care days	1.2 ± 5.0	(0–69)
Cost per hospitalization	$10,868 ± 12,813	($363–107,111)
No. of outpatient visits	7.0 ± 8.3	(0–60)
Cost per visit	$269 ± 307	($0–13,858)

*3/1/84–2/28/86

Temporal Changes in Utilization of Hospital Care

Table 4 shows the probability of hospitalization during each of the study years as well as the lengths of stay and the costs for hospitalization for those hospitalized. After adjusting for confounding variables, there was no important difference in rates of hospitalization between study years. However, once hospitalized, patients in year one had longer (3.1 days) and more costly ($2,432) lengths of stay.

Survival after AIDS Diagnosis and Lifetime Cost

Figure 1 contains the results of a Kaplan-Meier analysis of months of survival for two cohorts of patients, one cohort diagnosed in year one or earlier (n = 110) and the other diagnosed in year two (n = 130). Whereas individuals diagnosed in year one lived a median of 10 months after diagnosis those diagnosed diagnosed in year two lived a median of 17 months. We estimated lifetime hospital cost in each year as the product of unadjusted hospital cost and median survival. Although unadjusted hospital cost per year (inpatient and outpatient) decreased by 27 percent between year one and year two (from $41,075 to $29,929) (Table 2), estimated lifetime hospital cost increased by 23.8 percent (from $34,229 to $42,399).

Evaluation of Outliers

Interestingly, most of the observed temporal decrease in cost was related to the shorter length of stay and reduced cost for individuals hospitalized in year two. To evaluate the potential impact of outliers, we performed a test of significance of the prevalence of the 1 percent and 5 percent length

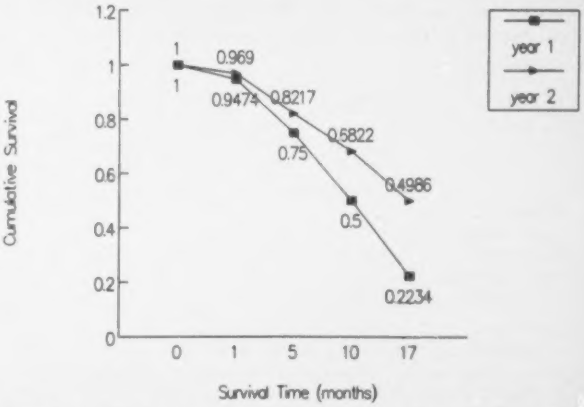

FIGURE 1—Kaplan-Meier Plots for Year of Diagnosis of the Proportion Surviving with AIDS

TABLE 3—Predictors of Hospitalization of AIDS Cases 3/1/84–2/28/86

Characteristics	Hospital Months	Total Months	Crude Relative Risk	Adjusted[*] Relative Risk	95% Confidence Interval	Exact[#] p-value
Age (Years)						
≤35	265	1144	-			.10
>35	169	679	1.07	1.23	(.95, 1.59)	
Gender						
Male	391	1687	-			.57
Female	43	136	1.36	1.04	(.60, 1.80)	
Transmission Category						
Homosexual/bisexual	329	1490	-			.15
IV Drug User	47	128	1.66	1.57	(.93, 2.67)	
Other	58	205	1.28	1.08	(.67, 1.73)	
Race						
White	302	1392	-			.40
Black	74	224	1.52	1.26	(.79, 2.00)	
Hispanic	58	205	1.29	1.38	(.94, 2.03)	
Site[^]						
Site 1	129	663	-			.12
Site 2	78	326	1.23	1.14	(.74, 1.76)	
Site 3	37	118	1.61	1.62	(.93, 2.80)	
Site 4	59	169	1.79	1.70	(.93, 3.13)	
Site 5	131	547	1.23	1.51	(1.09, 2.08)	
Mortality						
Alive	356	1710	-			.01
Dead	78	112	3.34	9.70	(6.25, 15.06)	
Insurance						
Blue Cross	128	545	-			.02
Commercial	59	313	.80	.73	(.50, 1.05)	
Public	139	482	1.23	1.17	(.85, 1.62)	
HMO	54	209	1.10	1.32	(.82, 2.14)	
None	54	224	.84	.70	(.46, 1.06)	
Number of Diseases						
More than one	282	1065	-			.01
One	152	758	.76	.64	(.48, .84)	
Initial Diagnosis						
P. *carinii*	211	821	-			.45
Kaposi's sarcoma	97	540	.70	.85	(.61, 1.18)	
PCP & Kaposi's	58	216	1.04	1.10	(.74, 1.65)	
Other OOI	68	246	1.08	1.12	(.77, 1.62)	
Time since diagnosis						
>3 months	283	1438	-			.01
≤3 months	151	385	1.99	2.92	(2.24, 3.79)	

[*] Controlling for all variables in the table.

[#] Comparing logistic models with and without the variable using an exact likelihood ratio test[20].

[§] Other = Heterosexual, Blood Related, or unknown categories.

[^] Site = Hospital which provided the majority of care.

of stay outliers by study year. The prevalence of both 1 percent and 5 percent outliers was significantly greater during the first year of the study. We then repeated both the length of stay and cost per hospitalization analyses with the 1 percent and 5 percent outliers removed. In the reanalysis we found that length of stay and cost per hospitalization remained significantly higher during the first year of the study.

TABLE 4—Temporal Changes in Use of Hospital Services

	Year One[*]	Year Two[*]	Crude[**] Difference	Adjusted[***] Difference	Exact p-value
Probability of hospitalization per month	0.27	0.25	0.02	0.01	.13
Length of stay per hospitalization (days)	20.6	16.8	3.8	3.1	.04
Cost for these hospitalizations	$12,463	$9,957	$2,506	$2,432	.05

[*] Year 1: 3/1/84–2/28/85, Year 2:3/1/85–2/28/86.

[**] All differences are year one minus year two.

[***] Adjusted for age, number and type of opportunistic infections, transmission category, race, site, mortality, insurance, gender, and time since diagnosis.

Discussion

Our results illustrate the importance of multiple factors that produce temporal changes in the cost of treating AIDS. These include changes in: patterns of treatment, length of patients' survival, and characteristics of the patient population. Our findings suggest that although the cost per patient per year may have decreased, overall lifetime costs may have increased because of improved survival.

In our population, there was little temporal variation in patients' clinical and sociodemographic characteristics. However, this is not likely to be true in the future. Regions of the country such as New York City and Massachusetts have demonstrated a recent increase in the incidence of AIDS among groups such as intravenous drug users.[23,24] Our analysis suggests that such characteristics may also be important predictors of hospitalization and associated cost.

While the median survival time in our study population was short (14 months), it must be kept in mind that all of the patients in our study were diagnosed prior to March 1986. Our cohorts' median survival was slightly longer than that observed in New York City during a similar period of time.[25] We assume that much of the increase in survival among individuals diagnosed during the second year is due to wider recognition of complications and changes in treatment. However, we were concerned some component may be due to lead time bias, an earlier diagnosis of disease, in which case our estimates for the differences in survival by year may be exaggerated. In order to assess this possibility, we reviewed surveillance records of patients diagnosed at the five study sites during the two time periods. We evaluated the method of diagnosis (n = 240), number of symptomatic months before diagnosis (n = 163), and the ratio of T-helper lymphocyte count to T-suppressor count (T-cell subsets) for those patients in which T-cell evaluations were performed and reported (n = 51). We found no significant differences in these indices by year of diagnosis. Hence, we feel that our findings are not likely to be a result of lead time bias.

Individuals with AIDS require a substantial amount of health care resources. In our study the mean cost of medical care was $37,404 per patient per year. Most other estimates have been in the $40,000 to $70,000 range.[8-16] These large costs have obvious implications for national health policy. Assuming an average lifetime cost of $42,399 per patient, the 110,000 AIDS patients already diagnosed will already require medical care expenditures of over $4 billion. The economic burden is substantial and may present a particular problem for teaching and public hospitals, where patients with AIDS tend to be hospitalized. It must be kept in mind that we assessed the direct medical care costs associated with treating AIDS and did not measure the indirect, nonmedical costs of AIDS, which may be enormous.

Several methodologic issues should be noted. As with virtually all cost-of-illness studies, we assessed average medical costs which may overestimate the incremental, i.e., marginal, medical cost of treatment. On the other hand, our results represent an underestimate of the total medical cost of treating a person with AIDS. Although we believe that the five hospitals in the study were the major source of medical care for the patients in our study, some patients may have received additional care at other sites. In addition, this study was performed before the licensure of AZT (azidothymidine). The annual cost of therapy with this medication is approximately $8,000 per patient per year[26,27] and it can be expected to have a major effect on both earlier diagnosis and survival after diagnosis.[28,29] We believe that both the methodology and results of our study will form a baseline to which later utilization studies may be compared.

Future studies of the economics of AIDS need to incorporate not only the actuarial estimates of the cost of care, but also clinical and organizational factors as well as life expectancy. The unique nature of this disease and its tremendous social and economic burden make such monitoring essential.

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The Impact of DRGs on Community-based Service Providers: Implications for the Elderly

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Abstract: We investigated changes in community-based agencies following the implementation of the Medicare prospective payment system for hospitals utilizing DRGs (diagnosis-related groups). Data were collected in 1986 and 1987 from 771 community service providers. There were five major findings: 1) hospital discharge planners, nursing homes, and home health agencies experienced DRG effects before other types of community providers studies; 2) the "reach" of DRG impact is widespread; 3) providers report a change in clientele toward a heavier-care client; 4) the impact of DRGs affects the types of services agencies provide; and 5) community providers have experienced a decrease in their ability to refer their clients both to hospitals and to each other. (*Am J Public Health* 1990; 80:840-843.)

Introduction

A number of research studies have focused on the short-term effects of the Medicare Prospective Payment System (PPS), particularly in terms of the utilization and cost of hospital services.[1-9] A limited number of studies have also focused on the effects of PPS on post-hospital care, although these have generally given primary attention to home health care and other Medicare-reimbursed services.[10-17] There has been little documentation, however, on the effects of PPS on a broader range of community-based service providers and, by extension, on the elderly population they serve. This important, but understudied, area of care is addressed here.

PPS-related early hospital discharge changed patterns of post-hospital service utilization, affecting community agencies, individuals and families.[18-26] The adequacy of the community-based service system to respond to new demands, either in the form of demand for new types of services or increased intensity of existing services, raises questions of access for the older adult population needing those services. While this study explores DRG (diagnosis-related groups) impact from an agency perspective and records organizational changes that service providers report making, it is possible, nonetheless, to suggest some of the ways in which these organizational changes will affect clients.

Methods

The research question asks post-hospital care organizations how DRGs have affected their staffing, service provision, and the types of clients served.

Data Sources

Study data were drawn from several sources:

- telephone survey interviews with a probability sample of seven types of service providers conducted in Spring of 1986 and again in Fall of 1987;
- telephone interviews with state and local policy makers and representatives of major provider associations ("key informants") in the states studied, conducted in 1988;
- detailed case studies and in-person interviews in two study communities;
- secondary data obtained from a variety of sources, including the Area Resource File, Census data, and the National Nursing Home Survey of 1985.

Site Selection

Sample States. States and SMSAs (standard metropolitan statistical areas) were selected purposively to assure some geographic variability. Each of the five states in the sample (California, Florida, Pennsylvania, Texas, and Washington) was the most populous state in its federal administrative region. They had also been identified by the regional directors of the Administration on Aging in 1976 as having the most innovative and generous aging programs in their regions. The states selected assured some diversity of sociodemographic and state economic conditions, factors that have been shown in other studies to affect expenditures and utilization of long-term care services. Our assumption is that, if we find shortfalls or gaps in these states, we would expect that the situation is likely to be as difficult or more so in smaller, less urbanized states.

Sample SMSAs. The SMSA was selected as the geopolitical unit from which to sample provider organizations because such catchment areas better represent the referral, market and interorganizational system for long-term care services than does a single city or county. In all cases one or two of the top four largest metropolitan areas (exceeding a population of one million) in the state were included in the study: Miami and Tampa/St. Petersburg; Philadelphia and Pittsburgh; Dallas/Ft. Worth and Houston; San Francisco/Oakland and San Diego; and Seattle. The sample represents nine of the 11 largest metropolitan areas in the five sample states and nine of the 24 largest metropolitan areas in the nation.

Provider Sample. The sample of provider organizations was selected randomly using probability sampling techniques, and the directors of each, or their designees, were interviewed by telephone for 30 to 60 minutes. The survey instrument contained both close-ended and open-ended questions covering the topics of: organizational structure; staffing patterns; clientele; service patterns; budgetary sources; opinion questions on policy issues; and perceptions of DRG effects in specific areas. This article presents the responses to the questions on DRG impact.

The service provider sample is comprised of a total of 771 respondents, representing seven different service providers interviewed in 1986 and again in 1987. This combined data set consists of: 178 discharge planners, 166 home health

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agencies, 166 nursing homes, 39 adult day care centers, 104 senior centers, 24 hospices, and 94 community mental health centers, rendering a total of 1542 interviews.

In 1986, respondents were asked to report on events and describe organizational changes occurring between 1984 and 1986 (to tap the immediate period of DRG implementation). In 1987, respondents were asked to report on events and changes occurring between 1986 and 1987. Thus, the data collected cover the period from 1984 to 1987.

Results

Five major findings emerged from the study (selected tables are in the text; further data may be requested from the authors).

- **First and Second Generation Effects.** In response to an open-ended question asking respondents to identify the policy that had most effect or impact on their organization during the time period studied, the policies that were most frequently nominated, in rank order, were DRGs and other Medicare policies (Table 1).

The types of DRG effects agencies described included increased demands as a result of earlier release of older hospital patients still needing some form of care. The other Medicare policies nominated were associated with reimbursement such as problems with fiscal intermediaries and inadequate reimbursement.

Table 1 also illustrates the lag time in reported DRG effect by different types of agencies. The "first generation" effects of DRGs (1984–86) were most immediately and directly experienced by hospital discharge planners, nursing homes, home health agencies and, to a much lesser degree, community mental health centers. In 1987, however, the percentage of these providers nominating DRGs as the most important policy affecting them declined, while adult day care centers and hospices reported being affected by DRGs for the first time.

While the one-fourth of adult day care centers reporting DRG effects is not large, the reason given for the impact, we believe, heralds an important trend. Adult day care centers reported that they were receiving more post-hospital patients referred from home health agencies after their Medicare benefits were exhausted, but before their care needs were met. This reason also explains the dramatic increase in the percentage of day care centers that reported being affected by other Medicare policies. At present adult day care services are paid for privately or by Medicaid, but not by Medicare. These centers believe the care they are now offering should be covered by Medicare as well.

TABLE 1—Percentage of Providers Reporting DRGs and Medicare Policies as the Most Important Policies Affecting Their Agencies

	1986*		1987**		
Agency Provider Type	DRG	Medicare	DRG	Medicare	N
	%	%	%	%	
Discharge Planners	90.4	10.7	62.3	12.4	(178)
Nursing Homes	28.2	12.4	24.1	13.2	(166)
Home Health Agencies	36.7	41.0	12.6	33.7	(166)
Community Mental Hlth	6.4	0.0	0.0	0.0	(94)
Adult Day Care	0.0	0.0	12.8	25.6	(39)
Hospice Programs	0.0	66.7	25.0	79.2	(24)
Senior Centers	0.0	0.0	0.0	0.0	(104)

SOURCE: IHA, DRG Study, Provider Instruments, 1986, 1987. "Please tell me what policies, or interpretations of policy, have had the greatest impact on your agency in the past twelve months, and what that impact has been."

*Data are for the 1984–86 time period.

**Data are for the 1986–87 time period.

- **The "Reach" of DRG Effects.** When we calculated the percentage of all providers reporting at least one type of DRG impact, we found that all seven types of providers reported being affected by DRGs in at least one of the following ways: types of clients served, services required or provided and/or referral patterns. The percent of providers reporting one or more types of DRG impact ranged from a low of 58 percent of senior centers to a high of 98 percent of discharge planners (table not shown). This is additional evidence that DRG effects were experienced not only by medical service providers but also by social service providers.
- **Change in Type of Client.** Providers were asked if they experienced changes in the types of clients they serve as a result of DRGs. As expected, the organizations most likely to receive patients directly following hospital discharge (home health agencies, hospices, and nursing homes) more frequently reported this type of DRG effect. Interestingly, however, even one-third of senior centers reported a change in clientele linked to DRGs (Table 2).

When asked to indicate *how* their clientele had changed, the predominant response across providers, was that clients were more frail, physically sicker and/or in need of more acute care services than in the previous study period. Overall, 60 percent reported this in 1986 and 57 percent in 1987.

- **Change in Services.** The increased tendency for clients to be heavier-care is also reflected in the responses to questions about DRG effects on services (Table 3).

Discharge planners differ from other providers in that their function is to assess and arrange for services needed by hospital patients upon discharge. Their most frequently mentioned service changes were in outpatient services and increases in the amount of discharge planning done by the hospital. For home health agencies, hospice programs, and nursing homes, the most frequently reported shifts in service were toward: more acute high-tech care; more skilled nursing; and more antibiotic intravenous therapy. Home health agencies reported this type of impact first (1984–86), while nursing homes and hospices reported more shifts of this type between 1986–87. Senior centers most frequently reported

TABLE 2—Percentage Reporting They Have Experienced a Change in the Types of Clients Served

Agency Provider Type	1986*	N	1987**	N
	%		%	
Home Health Agencies	92.1	(165)	82.3	(164)
Hospice Programs	87.5	(24)	60.9	(23)
Nursing Homes	84.3	(166)	87.2	(164)
Discharge Planners	71.3	(174)	70.9	(175)
Adult Day Care	52.6	(38)	43.2	(37)
Community Mental Health	30.8	(91)	40.7	(91)
Senior Centers	***	***	34.0	(94)

SOURCE: IHA, DRG Study, Provider Instruments, 1986, 1987.

"As a result of Medicare DRG payment to hospitals in the area you serve, has your agency experienced any of the following: a) Changes in the types of clients you serve?"

*Data are for the 1984–86 time period.

**Data are for the 1986–87 time period.

***Question not asked of senior centers in 1986.

TABLE 3—Percentage of Providers Reporting Changes in Services as a Result of DRGs

Agency Provider Type	1986* %	N	1987** %	N
Home Health Agencies	75.5	(163)	63.4	(164)
Hospice Programs	75.0	(24)	56.5	(23)
Discharge Planners	68.9	(177)	*	*
Nursing Homes	55.2	(165)	55.2	(165)
Adult Day Care	36.8	(38)	34.2	(38)
Community Mental Health	33.3	(90)	27.5	(91)
Senior Centers	***	***	29.0	(100)

SOURCE: IHA, DRG Study, Provider Instruments, 1986, 1987.

"As a result of Medicare DRG payment to hospitals in the area you serve, has your agency experienced any of the following: b) Shifts in the kinds of services you provide?"

*Data are for the 1984–86 time period.

**Data are for the 1986–87 time period.

***Question not asked of that provider type that year.

providing increased information and referral services, and adult day care centers reported providing more direct supervision and more rehabilitative therapy. Community mental health centers reported case management was increased as were services for the chronically ill.

As an additional indicator of whether or not patients were being released with more medically related needs, a question was asked about changes in the units of service required as a result of DRGs. The majority of providers reported changes in the units of service now required by their clientele. For both years of the survey, the reported changes were in the direction of increased units of service required—either increases in the number of visits or increases in the length of time of care per patient.

- **Change in Referral Ability.** A substantial percentage of agencies reported change in their ability to refer clients to hospitals (Table 4). The most frequently reported change was an increased difficulty in referring clients from community service providers *to* hospitals due to stricter hospital admission policies making *both* admission and re-admission more difficult. This problem was reported more frequently in 1986 than in 1987, although a sizable proportion of providers were still reporting difficulty in 1987.

Not all providers were queried in both 1986 and 1987 about changes in their ability to refer to other community providers (all providers were asked in the 1987 survey). However, of the three types of agencies for which there are data for both 1986 and 1987, discharge planners and home health agencies were more likely to report changes in their ability to refer to other agencies in 1986 than in 1987. The proportion of adult day care centers remained virtually the same both years. The direction of the change reported was an increased difficulty in referring clients to other community agencies

TABLE 4—PERCENTAGE OF AGENCIES REPORTING CHANGES IN ABILITY TO REFER TO HOSPITALS

Agency Provider Type	1986*	N	1987**	N
	%		%	
Hospice Programs	58.3	(24)	40.0	(20)
Community Mental Health	43.3	(90)	38.6	(88)
Home Health	35.7	(154)	25.5	(161)
Nursing Homes	30.5	(164)	25.9	(166)
Adult Day Care	20.6	(34)	18.8	(32)

SOURCE: IHA, DRG Study, Provider Instruments, 1986, 1987.

"As a result of Medicare DRG payment to hospitals in the area you serve, has your agency experienced any of the following: d) Changes in your ability to refer clients to hospitals?"

*Data are for the 1984–86 time period.

**Data are for the 1986–87 time period.

Most disturbing is the number of discharge planners who reported changes in the direction of increased difficulty in referring their hospital patients to other agencies for both time periods of the survey. In 1986, 31 percent of all discharge planners interviewed (N=178) reported increased referral difficulty due to fewer resources and more difficulty in gaining admission to nursing homes. In 1987, that percentage increased slightly to 34 percent and was reported to be due to: more difficulty in obtaining homemaker/chore services, fewer resources available in general and longer agency waiting lists.

Discussion

Study data suggest that the community-based service system is becoming saturated with physically sicker, heavier-care clients filtering down through the post-hospital community care services, affecting the service packages of both medical and social service agencies. There are three potential implications for the clients of these provider agencies:

- If the situation continues to move in the direction begun with PPS, there is likely to be a trade-off between our society's ability to meet the needs of the post-acute elderly as opposed to needs of the chronically ill elderly who have not been recently hospitalized. This could create problems of access for the chronically ill elderly residing in the community.
- Medicare coverage for services outside of the acute care setting is extremely limited. An increased need for these services can be expected to increase the already high out-of-pocket health care expenses of the elderly, creating problems of access for older persons with limited financial capacity.
- In other sections of our survey not dealing with DRGs specifically, we found that agencies were depending more on family caregivers. Increasing attention is being given to informal caregiving as a means to control costs. Insofar as possible, we expect that the informal care sector represents the "third generation" of DRG effects, as responsibility for care of the disabled and chronically ill older adults continues to shift to the informal sector.

We have examined some of the short-term effects of DRGs on a number of community agencies but we do not know how long-term these effects may be nor can we generalize our findings beyond the agencies and SMSAs studied. Continuing and more detailed research on the services and clients of providers is needed to determine if beneficiary access to both post-acute care and chronic care is adequate and whether the shifts of the type we describe are occurring more generally. Our findings also need to be further validated and complemented by research on the case-mix and service-mix of organizations of the type studied here. Given the probability method of sampling and the high response rates within the sample SMSAs, however, we are confident in, and disturbed by, our results.

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American Cancer Society Research Grants in Primary Prevention and Detection

The American Cancer Society is expanding its research program in psychosocial and behavioral aspects of cancer to include primary prevention and detection. Investigators are encouraged to submit research and clinical grant proposals, and requests for support of personnel in research (Postdoctoral Fellowships, Physician's Research Training Fellowships, Junior Faculty Research Awards, Faculty Research Awards, and Scholar Awards) in these areas.

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The Prevention of Intellectual Impairment in Children of Impoverished Families: Findings of a Randomized Trial of Educational Day Care

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Abstract: We estimated the effects of an experimental educational day care program on the intellectual development of preschoolers from 86 high-risk families in a randomly allocated longitudinal study. At six through 54 months of age, the IQs of experimental program children ranged from 7.9 to 20.1 points higher than those of control children when maternal mental retardation and home environment effects were controlled; at every age, a greater proportion of the experimental program children had normal range IQs (> 84). In 13 children with retarded mothers, none of six experimental program children, but six of seven control children, had IQ scores below normal. (*Am J Public Health* 1990; 80:844–847.)

Introduction

Mild mental retardation is more prevalent among lower socioeconomic groups, unlike moderate, severe, and profound mental retardation which are fairly evenly distributed across socioeconomic groups.[1] Family and social problems of many low income families (e.g., low education, unemployment) have been associated with impaired intellectual functioning in general, and mild mental retardation in particular.[2,3] These findings, in combination with those of national surveys showing that 25 percent of the nation's preschool age children live in poverty,[4] suggest that mild mental retardation should be an important public health concern.

Preschool programs designed to enhance the intellectual development of high-risk children have generally been associated with positive outcomes; however, the intellectual gains associated with the programs are often of limited duration.[5]

The goal of this report is to evaluate simultaneously the effects of an educational day care program (i.e., the Carolina Abecedarian Project) and familial factors, specifically maternal retardation and home environment, on the intellectual development of high-risk children throughout their first four and a half years of life. Previous investigation of this sample found that educational day care led to improved intellectual functioning;[6*] however, the impact of multiple potentially confounding factors was not evaluated.

Methods

Intervention Procedures

The Carolina Abecedarian Project is a randomly allocated, controlled, longitudinal investigation of the effectiveness of educational day care in enhancing the intellectual ability of children from impoverished multi-problem families. Children assigned to the experimental condition entered day care between 6 and 12 weeks of age, and remained in care for five days a week, 50 weeks a year. The program was designed to promote social and cognitive growth in an orderly, friendly environment.[7,8]

Sample Selection

A total of 120 pregnant women whose unborn children (the target children) were at high-risk for intellectual impairment were identified by public health agencies and hospitals. High-risk status was defined by an index score composed of 14 risk factors for intellectual impairment.[9] Of the 120 families randomly assigned to either the experimental or control group, 107 continued participation for at least 54 months.[6] This report focuses on 86 (80 percent) of these 107 families for whom complete follow-up information is available (41 experimentals and 45 controls). No statistically significant differences were detected between the 86 families with complete information and the 21 families with incomplete information in terms of condition assignment, maternal IQ, or maternal education.

Table 1 shows the sociodemographic comparability of the experimental and control groups at study enrollment. Study families were primarily Black, low-income, single parent families. Mothers tended to be young and to have low IQs and low education levels. Target children were predominantly firstborns.

Assessment Instruments

The intellectual development of the children was evaluated using three standardized developmental and IQ tests.

TABLE 1—Characteristics of the Families at Study Enrollment

Characteristics	Control Group (n = 45)	Experimental Group (n = 41)
	n (%)	*n (%)*
Race		
Black	45 (100)	39 (95)
White	0 (0)	2 (5)
Firstborn		
Yes	27 (60)	28 (68)
No	18 (40)	13 (32)
Marital Status		
Single	31 (69)	31 (76)
Other	14 (31)	10 (24)
	X̄ (SD)	*X̄ (SD)*
Maternal age (years)	21 (6)	20 (4)
Maternal IQ (mean)	84 (11)	85 (13)
Maternal education (years)	10 (2)	10 (2)

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The Mental Development Index of the Bayley Scales of Infant Development[10] was used for assessments at 6, 12, and 18 months of age, the Stanford-Binet Intelligence Scale[11] for ages 24, 36, and 48 months, and the McCarthy Scales of Children's Ability[12] for ages 42 and 54 months.

For some analyses, children were classified into one of three groups on the basis of their IQ scores. Employing standard clinical cutpoints,[13,14] children with IQs of 70 or less were categorized within the mentally retarded range of intellectual ability, children with IQs between 71 and 84 fell within the borderline intellectual functioning range, and children who scored 85 or more fell within the normal range of intellectual ability; children could move across groups dependent upon their test scores at particular ages.

The Home Observation for Measurement of the Environment (HOME)[15] was employed to quantify the degree to which each child's home surroundings provided an age-appropriate, potentially stimulating environment. The 45-item infant version HOME was administered at 6, 18, and 30 months, and the 80-item child version at 42 and 54 months. The mean HOME scores of the experimental and control groups were comparable at each of the five assessments and evidenced little within-family variation over time.[16] Therefore, the five evaluations were summed to create a HOME-SUM score representative of each child's home environment throughout the follow-up. For purposes of analysis, the study homes were categorized into two groups: "more stimulating" homes (i.e., homes at or above this sample's mean HOME-SUM score), and "less stimulating" homes (i.e., homes below this sample's mean HOME-SUM score). Twenty-two (54 percent) of the experimental families were classified as having more stimulating homes, as were 19 (42 percent) of the control families.

Analyses

Descriptive statistics were calculated to compare the experimental and control children in terms of their mean IQ scores and the proportion of children who fell within the mentally retarded, borderline, and normal IQ ranges. A repeated measures multivariate analysis of variance procedure[17] was employed to evaluate the effects of the experimental day care on the IQ scores of the study children across time, while controlling for, and examining the impact of, familial factors. The children's IQs were modeled using the following predictor variables: experimental educational day care (yes or no); maternal mental retardation (yes or no); home environment (more or less stimulating); annual family income; maternal age; maternal education level; maternal marital status; and the number of siblings. Using a backward elimination modeling strategy,[18] the full model was reduced to a smaller final model containing educational day care, maternal retardation, and home environment. The Wilks Lambda criterion (with a type I error rate of .05) was used to evaluate all multivariate tests. Effect sizes were measured using estimated regression coefficients, and 95% confidence intervals were calculated.

Results

Table 2 shows that the mean IQ scores of the experimental program children were above the general population average of 100 at all but one assessment, unlike that of the controls. At all time points, a greater percentage of experimentals than controls fell within the normal range of intellectual ability. Furthermore, at all ages except 24 months, a greater percentage of controls fell within the mentally retarded range of intellectual ability. At 54 months, 93 percent of the experimentals vs 69 percent of the controls had IQs within the normal range.

The 13 children of mentally retarded mothers were examined in detail. At 6 and 12 months, the mean IQ scores of the six experimental program children of retarded mothers were comparable to those of the seven control children of retarded mothers, with all mean scores being slightly above 100. However, by the 54-month assessment, the mean IQ of the experimental program children of retarded mothers was 22 points higher than that of the control children of retarded mothers (95 vs 73). The IQ scores of six (86 percent) of the seven control children of retarded mothers fell below the normal IQ range at 54 months (three within the mentally retarded range and three within the borderline intellectual functioning range). However, the IQ scores of all of the six experimental program children of retarded mothers were within the normal IQ range at the final assessment.

The repeated measures multivariate analysis of the entire sample found that the experimental and control groups differed significantly in their overall level of IQ averaged over time when the effects of maternal retardation and home environment were controlled ($F_{(1,82)} = 49.12$, $p = .0001$), with the experimental group having a greater grand mean than the comparison group. The two groups also differed in their patterns of change in IQ across time ($F_{(7,76)} = 4.76$, $p = .0002$). Stepdown contrasts examining the differences in IQ between successive time periods found that the groups differed significantly on all comparisons except for those assessing change between the 6 and 12 month assessments and the 42 and 48 month assessments.

As shown in Table 3, positive educational day care effects were found at all ages, with the mean IQ of the experimental children averaging from 7.9 to 20.1 points

TABLE 2—Mean IQ, Standard Deviation, and the Number and Percentage of Children in the Mentally Retarded (IQ < 71), Borderline Intellectual Functioning (70 < IQ < 85), and Normal (IQ > 84) IQ Ranges at 6 through 54 Months of Age

	Control Group (n = 45)				Experimental Group (n = 41)			
Age (years)	Mean(SD)	Retarded(%)	Border(%)	Normal(%)	Mean(SD)	Retarded(%)	Border(%)	Normal(%)
6	101 (14)	1 (2)	2 (4)	42 (93)	110 (14)	0 (0)	0 (0)	41 (100)
12	105 (15)	1 (2)	3 (7)	41 (91)	114 (13)	0 (0)	0 (0)	41 (100)
18	90 (13)	4 (9)	6 (78)	35 (78)	111 (12)	0 (0)	0 (0)	41 (100)
24	85 (9)	0 (0)	24 (53)	21 (47)	98 (11)	0 (0)	3 (7)	38 (93)
36	84 (14)	6 (13)	17 (38)	22 (49)	104 (13)	0 (0)	2 (5)	39 (95)
42	93 (13)	2 (4)	10 (22)	33 (73)	104 (11)	0 (0)	2 (5)	39 (95)
48	89 (14)	6 (13)	13 (29)	26 (58)	103 (12)	1 (2)	1 (2)	39 (95)
54	91 (14)	4 (9)	10 (22)	31 (69)	101 (11)	1 (2)	2 (5)	38 (93)

TABLE 3—Estimated Regression Coefficients and Associated 95% Confidence Intervals

	Regression Coefficients (95% CI)		
Age in months	Educational Day Care	Maternal Retardation	Home Environment
6	8.2 (2.2,14.1)	1.7 (−6.9,10.3)	4.8 (−1.4,11.0)
12	7.9 (2.0,13.7)	1.0 (−7.4,9.4)	4.9 (−1.2,10.9)
18	20.1 (15.0,25.2)	−3.3 (−10.6,4.1)	6.6 (1.3,10.9)
24	12.7 (8.9,16.7)	−4.3 (−9.9,1.5)	5.1 (0.9,9.3)
36	18.6 (13.5,23.7)	−8.2 (−15.6,−0.8)	8.6 (3.2,13.9)
42	10.2 (5.8,14.7)	−12.2 (−18.6,−5.8)	5.3 (0.7,9.9)
48	13.2 (8.5,17.9)	−11.7 (−18.5,−4.9)	8.9 (4.0,13.8)
54	9.1 (4.5,13.8)	−11.8 (−18.5,−5.1)	7.9 (3.0,12.7)

Note that for the multivariate analysis: educational day care was coded as 1 if experimental, 0 if control; maternal retardation was coded as 1 if retarded (IQ < 71), 0 if not retarded (IQ > 70); and home environment was coded as 1 if more stimulating (HOME-SUM scores above the mean), 0 if less stimulating (HOME-SUM scores below the mean).

higher than that of the control children when the effects of maternal retardation and home environment were controlled. The estimated effects of maternal retardation vary with the age of the children, the coefficients being small and positive at 6 and 12 months, but negative and progressively larger from 18 months onward. By 54 months, children with retarded mothers had IQ scores which averaged 11.8 points lower than children with non-retarded mothers, when the effects of educational day care and home environment were controlled. The effects of a more stimulating home environment were positive at every time point and increased over time. By the final assessment, children with more stimulating homes had IQ scores which averaged 7.9 points higher than did the children with less stimulating homes, controlling for the effects of educational day care and maternal retardation.

Discussion

The findings suggest that educational day care, maternal intelligence, and home environment each contributes to the developmental course of children's intellectual abilities. However, some cautionary comments and explanations are in order.

First, since the IQ scores of the experimental program children were consistently greater than those of the controls, one may ask whether the intellectual advantage of the experimental group was the result of the educational day care or the initial allocation procedure (i.e., were the children most at risk for intellectual impairment disproportionately allocated to the control group?). The facts that random allocation procedures were employed to assign families to groups, that known risk factors were evenly distributed between the groups, and that the experimental children had been in day care for at least three months prior to the initial IQ assessment, argue for the IQ differences being attributable to the educational day care program. Furthermore, the initial similarity of the IQ scores of the experimental and control group children of retarded mothers (i.e., all scored within the normal IQ range at 6 and 12 months of age) and the later dissimilarity of their scores (i.e., only 14 percent of the controls were in the normal IQ range at 54 months of age, compared to all of the experimentals) supports the notion that the educational day care resulted in improved intellectual functioning.

Second, issues arise concerning the patterns of change in IQ seen in the experimental and control groups over time. The decline in IQ seen in both groups after 12 months of age may be the result of at least two factors. The norms for the 12-month Bayley may be outdated, resulting in over-estimation of the true abilities of some children.[19] If the assessments at 6 and 12 months are inflated estimates of the children's functioning, while the later assessments are more accurate estimates, one would expect to see the observed decline in both groups of children after the 12-month evaluation. The differential magnitude of the decline (i.e., the downturn in scores was greater for the controls than for the experimentals) may be because the 6- and 12-month assessments focused on motor behaviors, while the later assessments incorporate more verbal behaviors. Perhaps the deficits associated with an impoverished environment may be mostly cognitive and verbal, rather than motor. This also could explain why the greatest fall in mean IQ after the 12-month assessment occurred in the subgroup of control children of mentally retarded mothers.

Improvement in the control group's mean IQ after 36 months of age may be due to the beneficial impact of community day care programs since approximately half of the control families entered their children into licensed community day care programs when the children were around three years old. A recent study of the impact of community day care in this sample of children concluded that the controls benefited intellectually from the community day care experience, although not to the same degree as the experimentals benefited from the Abecedarian educational day care.[20]

The positive impact of educational day care was especially pronounced for the children with mentally retarded mothers. At 6 months of age, all experimental and control children of retarded mothers had IQ scores within the normal range; however, by 54 months, all experimental group children of retarded mothers, but only 14 percent of the control children of retarded mothers, had normal range IQ scores. Although the number of children with retarded mothers in this sample is small (n = 13), the strong beneficial impact of this intervention merits attention because these children are at extreme risk for intellectual impairment.[21,22]

Given the beneficial effect of early educational day care in this sample of children with retarded mothers, the question arises as to whether families such as these typically receive day care services for their children. Data from the US National Longitudinal Survey of Youth[23] suggest that this is not the case: only 6 percent of the lowest functioning mothers of preschoolers (i.e., those mothers who scored in the bottom 5 percent on a standardized achievement test) enrolled their children in day care, compared to 20 percent of the highest functioning mothers (i.e., those mothers who scored in the top 95 percent on the achievement test). Thus the children who may be in most need of educational day care do not tend to receive these services. Given the positive findings of the Carolina Abecedarian Project, the children of low functioning mothers appear to be a group which public health policies should target to receive high quality educational day care interventions.

In addition to the educational day care effect, this study found both maternal mental retardation and home environment to be independent predictors of children's IQ scores. By the final 54-month assessment, the IQ scores of the children of retarded mothers averaged 12 points less than those of the children of non-retarded mothers, and the IQ scores of the children from more stimulating homes averaged 8 points higher than those of the children from less stimulating homes, when the effect of the experimental day care was controlled.

Finally, one may ask whether educational day care programs for impoverished families are cost-effective. Although, to date, no specific cost-benefit analyses have been performed using the Abecedarian data, a study of the teenage mothers in the sample found that by the 54-month evaluation, mothers in the experimental group were significantly more likely to have graduated from high school and be self-supporting than were mothers in the control group.[24] Given the large numbers of teenage mothers and children living in poverty in the United States today, the provision of high quality educational day care services to impoverished families may be a feasible strategy aimed at the prevention of mild mental retardation.

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Individuals planning to attend pre-convention activities related to the American Public Health Association's annual meeting this fall in New York City should note that Yom Kippur falls on Saturday, September 29. For those pre-annual meeting participants who wish to attend Yom Kippur services, two New York City educational institutions offer services open to the public.

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  Tel: 212/678-8000
  (Two separate services are conducted: sex-segregated and open.)
- Columbia University
  116th Street and Broadway, NYC
  212/280-1754
  (Student-led services.)

Risk Factors for Syphilis: Cocaine Use and Prostitution

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Robert T. Rolfs, MD, Martin Goldberg, and Robert G. Sharrar, MD, MSc

Abstract: In Philadelphia, a large increase in syphilis among minority group heterosexuals began in 1986 and preceded similar increases elsewhere in the United States. To determine reasons for this increase, we conducted a case-control study in the metropolitan sexually transmitted diseases clinic during 1987 and 1988. Cocaine use (odds ratio [OR] 3.1; 95% confidence interval [95% CI] = 1.5, 6.5 among men; OR 5.8; 95% CI = 1.5, 33 among women) and exchange of drugs for sex (OR 3.5; 95% CI = 1.4, 8.7 among men) were risk factors for syphilis. Although cocaine users reported more sexual partners and more frequently reported sex with prostitutes, cocaine use remained a risk factor after adjustment for these behaviors. These data suggest that sexual behavior or another factor, such as availability or utilization of health care, among cocaine users leads to increased risk of syphilis in this population. Increases in cocaine use may be partly responsible for recent increases in syphilis incidence in the United States. (*Am J Public Health* 1990; 80:853–857.)

Introduction

In 1986, the incidence of reported primary and secondary syphilis in Philadelphia, Pennsylvania was 38.0 cases per 100,000 persons, a 62 percent increase compared to 1985. This increase reversed a four-year period of declining syphilis incidence in Philadelphia. The increase continued during 1987 and 1988, reaching 71.9 cases/100,000 in 1988. This increase preceded increases in other areas, such as New York City, California, and Florida.[1] In Philadelphia, as in the rest of the United States, increases were greatest for Black and Hispanic heterosexuals.[2]

Reports by syphilis interviewers, and a review of interview records between 1985 and 1987,[3] suggested that an increasing proportion of syphilis patients were users of illegal drugs, especially of smoked or "crack" cocaine. In addition, use of smoked cocaine increased during this period in Philadelphia and in many other metropolitan areas experiencing increases in syphilis.[4,5] Authorities suggested that cocaine-addicted female prostitutes, exchanging sex for a dose of "crack" cocaine, were responsible for syphilis outbreaks in Philadelphia and elsewhere. To test this hypothesis and to explore the relation between cocaine use and syphilis, we conducted a prospective case-control study of risk factors for syphilis in the sexually transmitted disease (STD) clinic operated by the city of Philadelphia.

Methods

Subjects

Consecutive patients diagnosed with primary and secondary syphilis and latent syphilis of less than six months duration and interviewed for partner notification at the STD clinic were enrolled as cases. Interviews occurred between September 1987 and January 1988. We accepted a clinical diagnosis of syphilis if confirmed by review of test results by the syphilis interviewers. During the study period, 82 percent of reported syphilis cases were interviewed for partner notification. We excluded patients whose partner notification interview occurred outside of the STD clinic (approximately 30 percent of interviews) because information obtained in these settings might not be comparable to that obtained in the STD clinic.

Controls were recruited from among other patients seen in the STD clinic during the same time period. We enrolled as controls consecutive patients seen in the clinic during specified periods of the day and week who had not had syphilis during the past six months. Since anecdotal evidence suggested that gonorrhea was also linked to cocaine use, we also excluded patients with gonorrhea from the control group. All male controls with symptoms or signs of urethritis and all female controls had negative cultures for gonorrhea. All patients were tested serologically for syphilis.

Measurements

A standard questionnaire administered to all patients by STD interviewers recorded demographic data, STD history, reason for coming to the clinic, site at which medical care was initially sought, medical diagnoses and laboratory test results from that clinic visit, as well as specific questions about sexual and drug use behavior during the three-month period before the clinic visit. This time interval was chosen to be short enough for accurate recall but long enough to reflect behavior during the period immediately before infection for most patients. The questionnaire was administered before the usual partner notification interview for syphilis patients.

We abstracted results of partner notification efforts conducted on syphilis patients, after completion of the study. We recorded the number of exposed sexual partners identified and the outcome of partner notification efforts for each identified partner. The abstracter was blinded to the patients' questionnaire results.

Analysis

We calculated crude and adjusted odds ratios and 95% confidence intervals using standard methods.[6,7] We used chi-square analysis or Fisher's exact test to compare categorical variables and Student's t test and the Wilcoxon rank-sum test to compare continuous variables.

We used the Statistical Analysis System logistic regression package[8] for multivariate analyses. Separate logistic regression models were used for men and women to adjust for confounding variables. Variables examined in these analyses included: age, race, education, histories of syphilis and gonorrhea, reason for coming to clinic, location of residence

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within the city, and numbers of sexual partners in the last three months and last five years.

Results

We initially enrolled 170 syphilis patients (cases) and 166 controls in the study. Twenty percent of cases had primary syphilis, 36 percent had secondary syphilis, and 44 percent had latent syphilis. Sixty-nine percent of controls received a diagnosis associated with *Chlamydia trachomatis* (non-gonococcal urethritis, mucopurulent cervicitis, pelvic inflammatory disease), 10 percent were diagnosed with trichomoniasis, 5 percent with pubic lice, 5 percent with genital warts, 2 percent with genital herpes, and 1 percent with chancroid. Fourteen patients (9 percent) received more than one STD diagnosis. In 16 percent of control patients, no sexually transmitted infection was detected.

Nineteen percent of male cases reported sex with another man compared with 7 percent of controls. All men reporting sex with another man were excluded from the rest of these analyses, since the goal of this study was to determine reasons for the increase in syphilis among heterosexuals.

Among heterosexuals, cases were more likely than controls to be women and of Hispanic origin, and had completed fewer years of school (Table 1). The number of sexual partners reported in the last three months and the last five years were not significantly different between cases and controls. Controls were more likely to have come voluntarily to the clinic for care while over half of cases were detected by serologic screening or health department partner notification efforts. Controls were significantly more likely to have a past history of gonorrhea but history of syphilis was not different.

Use of cocaine during the three months before the interview was significantly more common among both male and female cases (Tables 2 and 3). Among men, having given a woman drugs in exchange for sex, having had sex with a woman met at a "crack house" or a place where drugs are sold or used ("crack house" sex), and sex with a woman on the same day she was met (first day sex) were also risk factors for syphilis. Twenty-six of 27 men, for whom the specific drug exchanged for sex was recorded, reported trading cocaine for sex. These associations persisted after adjustment for age, race, education, location of residence within the city, and whether the patient presented voluntarily to the city STD clinic for care, using logistic regression (Table 2). Adjustment for the number of sexual partners reported in the last three months and five years also did not change the risk estimates.

Among women, having accepted money or drugs for sex (prostitution) was more common among cases than controls (Table 3). "Crack house" sex and first day sex were uncommon among women and were not associated with syphilis. We could not obtain valid adjusted odds ratio estimates for women using logistic regression, because of the small number of female subjects. Odds ratio estimates were not reduced in any case, however.

When we examined route of cocaine use, the patterns of association were somewhat different for men and women, although the small number of women limits these comparisons. Among men, the strongest association was with intravenous cocaine use, although non-intravenous use was more commonly reported and was also a significant risk factor for syphilis. In contrast to men, non-intravenous cocaine use, primarily by the nasal route, was the strongest risk factor for syphilis among women. In this population, nearly all intravenous drug users reported using intravenous cocaine.

TABLE 1—Characteristics of Heterosexual Patients in Study, Philadelphia 1987–88

Characteristics	Cases (n = 147)	Controls (n = 157)	P value
Age (median)	27	25.5	p = .003[a]
Sex			
Men (%)	95 (65)	126 (80)	p = .002[b]
Women (%)	52	31	
Race			
White (%)	12 (8)	9 (6)	p = .002[b]
Black (%)	116 (80)	144 (92)	
Hispanic (%)	17 (12)	3 (2)	
Unknown	2	1	
Education			
< high school (%)	58 (43)	34 (23)	p < .001[b]
12 (%)	66 (49)	80 (53)	
> 12 (%)	11 (8)	37 (25)	
Unknown	12	6	
Sexual partners (mean [median])			
Last 3 months			
Men	2.9 [2]	3.8 [2]	N.S.[a]
Women	2.1]1]	1.5 [1]	
Last 5 years			
Men	36.9 [10]	23.1 [10]	N.S.[a]
Women	7.5 [3]	8.4 [3]	
Reason for presentation			
Volunteer (%)	64 (44)	143 (92)	p < .00001[2]
Health department partner referral (%)	21 (15)	7 (4)	
Detected by serological screening (%)	59 (41)	6 (4)	
Unknown	3	1	
History of syphilis (%)	7 (5)	6 (4)	N.S.[2]
History of gonorrhea (%)	29 (20)	54 (34)	p = .004[2]

a) Wilcoxon rank-sum test
b) Chi-square test

TABLE 2—Risk Factors for Syphilis among Heterosexual Men in Philadelphia, 1987–88

Risk Behavior[a]	Cases (n = 95)		Controls (n = 126)		Odds Ratio (95% CI)	
	n	(%)	n	(%)	Crude	Adjusted[b]
No cocaine use	50	(53)	93	(74)	1.0	
Cocaine use	45	(47)	33	(26)	2.5 (1.4,4.5)	3.1 (1.5,6.5)
Cocaine, by route of use[c]						
Intravenous	10	(11)	1	(1)	18.6 (2.3, 150)	24.1 (2.0, 295)
Smoked	15	(16)	13	(10)	2.2 (0.9,5.3)	2.2 (0.8,6.3)
Nasal and unknown	20	(21)	19	(15)	2.0 (0.9,4.3)	2.7 (1.1,6.9)
Cocaine use, other than intravenous	35	(37)	32	(25)	2.0 (1.1,3.8)	2.5 (1.2,5.4)
Sex with prostitute	26	(27)	22	(17)	1.8 (0.9,4.7)	2.4 (1.1,5.4)
Sex with prostitute by what was exchanged[d]						
Drugs	21	(22)	14	(11)	2.3 (1.1,4.7)	3.5 (1.4,8.7)
Money	15	(16)	11	(9)	2.1 (0.9,4.7)	2.9 (1.03,8.5)
"Crack house" sex[e]	23	(25)	16	(13)	2.2 (1.1,4.5)	2.6 (1.1,6.2)
First day sex[f]	51	(54)	50	(40)	1.8 (1.03,3.0)	2.2 (1.1,4.4)

a) All behaviors refer to the 3 months prior to the interview.
b) Adjusted for age, race, education, geographic residence within the city, and whether patient presented voluntarily to STD clinic for care.
c) Route of cocaine use is classified hierarchically as follows: any intravenous, smoked but not intravenous, and nasal or unspecified route, but not intravenous or smoked.
d) Exchange of drugs and money are not mutually exclusive categories.
e) Sex with a woman met at a "crack house" or a place where drugs are sold or used.
f) Sex with a woman on the same day that woman was met.

TABLE 3—Risk Factors for Syphilis among Women in Philadelphia, 1987–88

Risk Behavior[a]	Cases (n = 52)		Controls (n = 31)		Odds Ratio (95% CI)
	n	(%)	n	(%)	
No cocaine use	33	(63)	28	(90)	1.0
Cocaine use	19	(37)	3	(10)	5.4 (1.4, 31)
Prostitution:	6	(12)	1	(3)	3.9 (0.4, 91)
"Crack house" sex[b]	2	(4)	3	(10)	0.4 (0.1,2.4)
First day sex[c]	8	(16)	6	(19)	0.8 (0.2,2.5)

a) All behaviors refer to the 3 months prior to the interview.
b) Sex with a men met at a "crack house" or a place where drugs are sold or used.
c) Sex with a man on the same day that man was met.

TABLE 4—Sexual Behavior Associated with Cocaine Use, Heterosexual Men, Philadelphia, 1987–88

Sexual Behavior[a]	Cocaine Use		No Cocaine Use		P value[b]
	n = 78	(%)	n = 143	(%)	
Exchanged money or drugs for sex	30	(38)	18	(13)	p < .001
Drugs for sex	28	(36)	7	(5)	p < .001
Sexual partners in last 3 months					
0–1	17	(22)	49	(35)	p < .01
2–3	33	(42)	69	(49)	
4–5	15	(19)	15	(11)	
6–10	8	(10)	4	(3)	
> 10	5	(6)	4	(3)	
First day sex	48	(62)	53	(37)	p < .001
"Crack house" sex	25	(32)	14	(10)	p < .001

a) All behaviors refer to the 3 month interval prior to interview.
b) All p values are by chi-square. Number of sexual partners in last 3 months yields a Wilcoxon rank-sum test p value < 0.001.

Cocaine use remained a significant risk factor after adjusting for sex with a prostitute among men (OR 2.4; 95% CI = 1.3, 4.4) and for prostitution among women (OR 4.6; 95% CI = 1.2, 31). Among men, "crack house" sex and having had sex with a prostitute appear to measure a common risk behavior. A large proportion of patients reporting "crack house" sex also reported having had sex with a prostitute, and no risk was attached to either risk factor when present alone, while risk was greatly increased when both behaviors were reported (OR, 6.2; 95% CI = 2.0, 19). Cocaine use remained a risk factor for syphilis after adjusting for "crack house" sex.

Cocaine users were more likely to report sex with a prostitute and other behaviors likely to increase syphilis transmission, such as greater number of sexual partners and first day sex (Table 4). Men who smoked cocaine reported the highest frequency of each of these behaviors. Women who used cocaine also reported more sexual partners in the last three months (mean, 3.7 compared to 1.2; $p < 0.01$) and were more likely to report prostitution (6/22 compared to 1/60; $p < 0.1$) than women who did not use cocaine.

Men with syphilis who reported IV drug use were significantly more likely to have been diagnosed with secondary syphilis (73 percent) than were men who did not report IV drug use (27 percent), and were somewhat less likely to have been diagnosed with primary syphilis (18 percent compared to 33 percent).

Partner notification results were available for 88 percent (130/147) of syphilis patients. While men who had sex with a prostitute and men who used cocaine reported significantly more sexual partners in the last three months than did men who reported neither risk behavior (means 4.3, 4.0, and 1.8, respectively; $p < 0.05$), the average number of exposed sexual partners identified for partner notification purposes was lower for men reporting sex with a prostitute and cocaine use than for men reporting neither behavior (0.7, 1.0, and 1.3, respectively; $p < 0.05$ for sex with a prostitute). Prostitution and cocaine use were not associated with partner notification effectiveness among women, but the number of women in each group was small.

Discussion

These data support the hypothesis that cocaine use and sexual behaviors related to it are risk factors for syphilis in Philadelphia. The association between syphilis and cocaine use was not fully explained by contact with prostitutes among men or by prostitution among women.

This study has several potential limitations. Data were collected in a public STD clinic in Philadelphia; results may not be generalizable to other locations or other health care settings. Moreover, our control group was chosen to control for factors related to the tendency to seek care at a public STD clinic. If cocaine use is also important in the transmission of other sexually transmitted infections, associations between syphilis and cocaine use would be underestimated. We excluded gonorrhea patients from the control group because of the possible link between gonorrhea and cocaine use; gonorrhea incidence was increasing in Philadelphia when the study began. The information we collected on gonorrhea patients suggests our concern was valid. Gonorrhea patients reported cocaine use and sex with prostitutes nearly as frequently as did syphilis patients. In contrast, no consistent differences in the frequencies of these behaviors existed among controls with different diagnoses. The exclusion of patients with gonorrhea is further supported by a report linking illicit drug use with spread of penicillinase-producing *Neisseria gonorrhoeae* in King County, Washington.[9]

Selection bias[10] could occur if, among persons with sexually acquired infection, cocaine users are more or less likely than nonusers to be seen for care in the STD clinic. If cocaine users are less likely to seek care, active syphilis case detection (laboratory screening and partner notification) could artificially increase the proportion of syphilis patients who are cocaine users, producing a spurious association between syphilis and cocaine use. Patients who presented voluntarily to the clinic were as likely to report cocaine use and prostitution as were patients detected by health department partner notification efforts and screening, so this bias was probably absent.

High-risk sexual behaviors, such as sex with prostitutes, were common among cocaine users and are partly responsible for the increased risk of syphilis associated with cocaine use. However, cocaine use remained a risk factor after adjusting for differences in these sexual behaviors and is not merely a marker for differences in sexual behavior. Cocaine use may indicate a population with a greater prevalence of syphilis, resulting in increased risk of infection for any given behavior. An increased prevalence of syphilis among cocaine users could result from differences in sexual behavior, such as those described here. Alternatively, drug use may reduce health care access or utilization, resulting in longer duration of infectivity and therefore increased transmission.

While smoked cocaine or "crack" has received attention as a possible cause of increases in syphilis incidence,[11] cocaine use by all routes was associated with syphilis in this population. Especially among men, intravenous cocaine was most strongly associated with syphilis. "Crack" use, which has increased dramatically in the populations most affected by syphilis and was most strongly associated with high risk sexual behaviors among drug users in this population, may be a more important factor in the current syphilis epidemic. However, the strong association with intravenous cocaine use, not explained by differences in sexual behavior among drug users in this study, may suggest the importance of some other factor, such as health care behavior.

The strong association with intravenous drug use could also be due to nonsexual transmission due to needle sharing. *Treponema pallidum* has been transmitted by blood transfusion and by needle injury during surgery.[12,13] Patients with transfusion-acquired syphilis are usually diagnosed during the secondary stage,[12] since without cutaneous inoculation no primary lesion occurs. Intravenous drug users in this study were somewhat less likely to be diagnosed during the primary stage of syphilis. Further studies are warranted to determine if *T. pallidum* is transmitted by needle sharing.

Finding a history of gonorrhea more commonly reported by controls than by cases was unexpected. While gonorrhea incidence increased over this time period in Philadelphia, it decreased in the face of dramatic syphilis increases elsewhere in the United States. Cocaine-related behaviors which increased syphilis transmission would be expected to increase gonorrhea spread as well. Syphilis and gonorrhea may be distributed differently within the population,[14] providing one explanation for these otherwise surprising findings. Further study of differences between risk factors for syphilis and gonorrhea and of reasons for the divergence between trends in syphilis and gonorrhea incidence are needed.

Prostitution has increased syphilis transmission in the past,[15,16] although it has been overshadowed during the past two decades,[17,18] by the important role of homosexual and bisexual men in syphilis transmission during this time period.[19] Prostitution has also been linked to illegal drug use in the past,[20] often serving as a means of financing drug use. Our data suggest that trading sex for drugs, rather than for money, is an important risk factor for syphilis. However, an increased number of prostitutes and persons exposed to prostitutes, due to the greater availability and use of cocaine, is probably more important than whether drugs or money are exchanged.

Our results are consistent with data from Oregon which suggest that partner notification is less effective among persons trading sex for drugs.[21] Other tools of disease control, such as targeted screening and presumptive treatment,[22] may be useful in appropriately defined populations and settings. Since delay in seeking or gaining access to medical treatment may be important, barriers which prevent drug users from obtaining medical care should be removed.

HIV infection is more prevalent among heterosexual Blacks and Hispanics in inner cities than among heterosexuals in other settings, because of intravenous drug use-related transmission.[23] In addition to being important in needle use-related transmission,[24] cocaine use may also lead to increased sexual transmission of HIV. Because accumulating evidence suggests that genital ulceration is an important co-factor in HIV transmission,[25–27] the potential for sexual transmission within these settings is sizable.

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Workers Satisfied with Health Benefits, but Won't Pay More

Eighty-five percent of American workers are satisfied with their health care benefits, but they resist the idea of paying more for them or accepting less coverage, according to a poll by Northwestern National Life (NWNL) Insurance Company of Minneapolis. The survey involved interviews with 606 full-time employees whose health benefits are provided by private industry and state and local government.

Satisfaction with their benefits persisted whether they pay all, a portion, or none of the premium. However, many said they would contribute little, if anything, more to maintain current benefits: 39 percent said they would not pay even a dollar more; an additional 32 percent said they would agree to a monthly increase of less than $25.

A previous survey of 400 companies by NWNL last year had revealed that nine of 10 employers would soon ask workers to pay a much larger share of health care costs: 70 percent of employees felt the amount their employer now pays toward their health insurance is "about right." According to A. Foster Higgins and Company, employers contribute an average of $149 a month for each employee and his/her dependents for medical, dental, prescription drugs, and vision/hearing benefits.

Employees surveyed by NWNL this year indicated they view health benefits as an entitlement, and tend to be more satisfied with their plan when they have a choice of coverages and an understanding of their benefits. However, many employees are not aware of basic benefits information: 43 percent did not know the amount their employer pays as a premium; 53 percent did not know if their health plan covers catastrophic illness or injury which could run as high as $400,000 (most health plans do cover their expenses, the report noted). Asked about changes they would like, nearly one-third said they would like costs to be reduced; 25 percent would like broader coverage for routine doctor visits, dental care and prescriptions; 9 percent wanted more freedom to choose doctors and hospitals; some wanted fewer restrictions, such as the requirement for pre-authorized care. But 21 percent said they would not change anything.

The results of the report are in: Employee Satisfaction with Health Benefits, (conducted by Winona Market Research Bureau) NWNL, PO Box 20, Minneapolis, MN 55440. Tel: 612/342-7137.

The Increasing Frequency of Heterosexually Acquired AIDS in the United States, 1983–88

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Abstract: Of 88,510 cases of acquired immunodeficiency syndrome (AIDS) reported in adults in the United States from 1983 through 1988, the percentage attributed to reported heterosexual contact with persons known to be infected or at increased risk of infection with human immunodeficiency virus (HIV) has increased steadily from 0.9 percent in the first quarter of 1983 to 4.0 percent in the fourth quarter of 1988, from 0.1 (in 1983) to 1.4 percent (in 1988) among men, and from 13 (in 1983) to 28 percent (in 1988) among women. Among women, the cumulative incidence of AIDS attributable to heterosexual contact per million population is over 11 times greater for Blacks and Hispanics than for Whites. Among men, this incidence is over 10 times greater for Blacks and four times greater for Hispanics than for Whites. The pattern of distribution of heterosexually acquired AIDS parallels the distribution of other heterosexually transmitted diseases, which are also more frequent in Black and Hispanic inner-city populations. Drug use, exchange of sex for drugs or money, and early onset of sexual activity in adolescents are increasingly associated with heterosexually transmitted infections and are likely to be very important in heterosexual transmission of HIV in inner-city US populations. (*Am J Public Health* 1990; 80:858–862.)

Introduction

Early during the AIDS (acquired immunodeficiency syndrome) epidemic, there was considerable concern that AIDS would spread rapidly among heterosexuals in North America and Europe. These concerns were heightened by emerging evidence of heterosexual acquisition of AIDS in Africa. When the heterosexual AIDS epidemic did not rapidly materialize in industrialized countries, these concerns came to be regarded with skepticism. This paper provides an analysis of trends in the frequency and percentage of cases of AIDS in the United States thought to have been acquired heterosexually, together with a perspective on heterosexual transmission of HIV (human immunodeficiency virus) in the context of a general overview of heterosexually transmitted infections.

Methods

This report is based on the 88,510 adult (age at diagnosis at least 13 years) AIDS cases diagnosed in the United States between January 1, 1983 and December 31, 1988, and reported to the Centers for Disease Control (CDC) through June 30, 1989. AIDS case reporting is required in all states and territories, with individual city, state, and territorial health departments having the responsibility for surveillance. Each known case meeting a surveillance definition[1] is reported to CDC by the health department, with a likely mode of transmission based on a hierarchical definition (Appendix). If no risk factor for HIV infection is reported with the diagnosis, the health department contacts health care personnel and, if necessary, interviews the patient to obtain information concerning personal behavior, sexual contacts, and occupation that could result in exposure to HIV. A case is classified as "no identified risk" if the patient has died, is lost to follow-up, refused to be interviewed, could not be assigned to a risk group from the information obtained, or if information is still being sought.

In this report, we separate heterosexual transmission cases into two groups, corresponding to different epidemiologic characteristics and different trends over time. One group consists of cases classified as likely due to heterosexual transmission only because they were born in certain African or Caribbean countries where heterosexual contact is believed to play a major role in the transmission of HIV; these countries are designated by the World Health Organization as "Pattern II."[2] We concentrate on analyzing the remaining 2,637 heterosexual transmission cases that we designate as "reported heterosexual contact" cases. Of these 2,637 cases, 33 (1 percent) were born in these African or Caribbean countries but report heterosexual contact with intravenous drug users (IVDUs) (27 men, five women) or bisexual men (one woman).

We consider only cases of AIDS diagnosed after 1982 because the first reports of apparent heterosexual transmission were in late 1982.[3] Of the 1,394 adult cases of AIDS diagnosed before 1983, and not considered further here, two of the 1,305 men and 12 of the 89 women are classified as cases with reported heterosexual contact, and an additional 67 men and 10 women are classified as heterosexual cases due to birth in a "Pattern II" country.

Results

Trends in Heterosexually Acquired AIDS in US

The percentage of cases classified as due to reported heterosexual contact (as defined in Methods) increased from approximately 1 percent in 1983 to over 4 percent by the second quarter of 1988, while the percentage of cases classified as "heterosexual" cases in patients from "Pattern II" countries declined from over 4 percent in the first half of 1983 to about 1 percent by the end of 1988 (Figure 1). Only by separating these two groups can the increasing importance of known heterosexual contact cases be appreciated.[4] When these groups are not separated, no temporal trend in the percentage of AIDS cases due to heterosexual transmission is found.[5]

Table 1 shows the number and percentage of adult US cases of AIDS attributed to reported heterosexual contact for men and women by year of diagnosis (1983–88). The increase in annual percentages is especially striking for men (within each race/ethnicity group) and for non-Hispanic White women, but in no group was this increase steady over time.

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TABLE 1—Number and Percent[a] of Adult AIDS Cases in the United States Attributed to Reported Heterosexual Contact,[b] by Gender and Race or Ethnicity, Diagnosed during 1983–88.

Year of Diagnosis	Non-Hispanic White	Hispanic	Black	All[c]
	N (%)	N (%)	N (%)	N (%)
Men				
1983	0 (0.0)	0 (0.0)	2 (0.3)	2 (0.1)
1984	6 (0.2)	1 (0.1)	12 (1.0)	19 (0.4)
1985	9 (0.1)	2 (0.1)	21 (0.9)	32 (0.3)
1986	22 (0.2)	11 (0.5)	42 (1.2)	75 (0.5)
1987	77 (0.6)	28 (0.9)	105 (2.0)	212 (0.9)
1988[d]	116 (0.8)	49 (1.2)	161 (2.6)	328 (1.4)
All	230 (0.5)	91 (0.8)	343 (1.8)	668 (0.8)
Women				
1983	5 (10)	8 (18)	12 (13)	25 (13)
1984	12 (13)	21 (27)	31 (16)	64 (18)
1985	43 (21)	52 (34)	84 (22)	179 (24)
1986	100 (26)	85 (34)	158 (23)	347 (26)
1987	164 (25)	141 (34)	264 (23)	573 (25)
1988[d]	216 (29)	210 (37)	342 (23)	781 (28)
All	540 (25)	517 (34)	891 (22)	1969 (25)

[a] Of all adult cases with the same race/ethnicity and gender.

[b] Excludes cases in people without other identified risk factors who were born in "Pattern II" countries (see Appendix), where heterosexual transmission is believed to play a major role in HIV transmission.

[c] Includes cases in other races. In men, 2 of 486 cases in Asians, 1 of 87 in American Indians, and 1 of 187 in persons with race unknown are attributed to heterosexual contact. In women, the corresponding numbers are 13 of 44, 6 of 17, and 2 of 17.

[d] Reporting of cases is incomplete, especially for cases diagnosed in 1988.

TABLE 2—Cumulative Incidence[a] (1983–88) of AIDS Cases Attributed to Reported Heterosexual Contact, 1983–88, by Race, Ethnicity, and Gender

	Men		Women	
Race/Ethnicity	Cumulative Incidence	Ratio vs. whites	Cumulative Incidence	Ratio vs. whites
White	3.0	1.0	6.6	1.0
Black	32.6	10.7	73.6	11.1
Hispanic	13.2	4.4	74.1	11.2

[a] Per million persons, ages ≥13. The estimated population sizes, in thousands, for July 1988, were 81,563 for White women; 12,106 for Black women; 6,975 for Hispanic women; 75,868 for White men; 10,535 for Black men; and 6,869 for Hispanic men.

Persons born in Puerto Rico have been overrepresented in Hispanic heterosexual AIDS cases. Of the cases in men, 39 (43 percent) were known to be born in Puerto Rico; of those in women, 157 (30 percent) were born in Puerto Rico. In contrast, in 1980 less than 7 percent of all US Hispanics had been born in Puerto Rico.[6]

Although the rate of increase in the percentage of cases attributed to reported heterosexual contact has been greatest for men, the absolute percentage of cases attributed to reported heterosexual contact is much greater for women. For cases of AIDS diagnosed during 1988, the overall percentage of cases attributed to reported heterosexual contact is 20 times higher for women than for men, and the actual number of cases also was higher for women from 1983 through 1988. The female to male ratio of the number of heterosexually acquired cases for 1988 was 1.9:1 for Whites, 2.1:1 for Blacks, and 4.3:1 for Hispanics.

Although the percentage of reported cases of AIDS attributed to reported heterosexual contact does not differ greatly by race or ethnicity, the cumulative incidence of such cases (1983–88) was much higher for Blacks and substantially higher for Hispanics than for Whites (Table 2). The cumulative incidence of such cases per million adults, 1983–88, was over 10 times higher for Black men and four times higher for Hispanic men than for White men. Among women, the incidence was more than 11 times higher for Blacks and Hispanics than for Whites. As discussed below, this is similar to what is currently seen for certain other sexually transmitted diseases.

The temporal pattern of the percentage of cases attributed to heterosexual acquisition by women may also be somewhat different from that seen in men. In each racial group, there was an appreciable percentage of heterosexual cases in women as early as 1982 (at least 6 percent in each group, data not shown). The percentage has increased most rapidly among White women, from 10 percent in 1983 to 29 percent during 1988.

Source of Heterosexually Acquired AIDS

Table 3 summarizes the distribution of the sex partner's risk group for cases of AIDS attributed to reported heterosexual contact, by race and gender of the index person with HIV infection. IVDUs comprised a substantially lower percentage of the male sex partners for White than for Black or Hispanic women. Bisexual men comprised a much larger percentage of the male sex partners for White women with AIDS than for Black or Hispanic women with AIDS.

The racial distribution of female heterosexual AIDS cases stating that their contact was an IVDU (20 percent White, 31 percent Hispanic, 48 percent Black) was nearly identical to the corresponding racial distribution of male IVDU AIDS cases diagnosed during 1983–88 (19, 33, and 48 percent, respectively). Whites were overrepresented and

TABLE 3—Distribution of Partner's Risk Group for Reported Heterosexual Contact AIDS Cases,[a] by Race, Ethnicity, and Gender of Index AIDS Case, for Cases Diagnosed during 1983–88

Partner's Risk Group	Non-Hispanic White	Hispanic	Black	All[b]
	N (%)	N (%)	N (%)	N (%)
Men				
Intravenous drug user	148 (64)	67 (74)	270 (79)	487 (73)
Pattern II[c]	17 (7)	3 (3)	17 (5)	37 (6)
Blood product transfusion	8 (3)	0 (0)	4 (1)	14 (2)
Other[d]	57 (25)	21 (23)	52 (15)	130 (19)
All	230 (100)	91 (100)	343 (100)	668 (100)
Women				
Intravenous drug user	273 (51)	439 (85)	679 (76)	1400 (71)
Bisexual	138 (26)	35 (7)	86 (10)	262 (13)
Pattern II[c]	0 (0)	0 (0)	24 (3)	24 (1)
Blood product transfusion	37 (7)	5 (1)	3 (0)	46 (2)
Hemophiliac	27 (5)	1 (0)	2 (0)	31 (2)
Other[d]	65 (12)	37 (7)	97 (11)	206 (10)
All	540 (100)	517 (100)	891 (100)	1969 (100)

[a] Excludes cases in people without other identified risk factors who were born in Pattern II countries (see Appendix), where heterosexual transmission is believed to play the major role in HIV transmission.

[b] Includes 4 men and 21 women of other races (see Table 1).

[c] 21 of 37 men and 23 of 24 women were Haitians; the remaining 17 cases were born in sub-Saharan Africa.

[d] 101 men and 179 women with heterosexual partner with HIV infection or AIDS but risk group not specified; 17 men and 14 women with heterosexual partner with uncertain HIV status and no indicated risk group; and 3 men with infected female partners who received clotting factors.

Hispanics were somewhat underrepresented in the male heterosexual AIDS cases stating contact with an IVDU compared to the racial distribution of female IVDU AIDS cases diagnosed 1983–88; the distributions were 30 percent White, 14 percent Hispanic, and 55 percent Black for male heterosexual cases reporting contact with an IVDU vs 22, 20, and 58 percent, respectively, for female IVDU cases.

Bias in Attribution

A possible source of bias is denial of other risk factors, such as IVDU and homosexual contact, perhaps as a result of an increasing awareness of heterosexual transmission. We examined the diseases present at diagnosis (Appendix). Of the 13,927 AIDS cases diagnosed in men during 1981–88 which included a report of Kaposi's sarcoma (KS), 13,177 (95 percent) were in homosexual or bisexual men (including 1,217 who were also IVDU). If the increase in the proportion of male cases attributed to heterosexual contact was primarily due to denial of homosexual contact, we would expect the percentage of reported heterosexual contact cases who had KS to change during 1984–88 to resemble the corresponding percentage in homosexual transmission cases more than the percentages in IVDUs and transfusion recipients.

We examined the annual percentages of male AIDS cases with KS during 1984–88 in these risk groups (Table 4). The percentage of AIDS cases in homosexual or bisexual men with KS declined during this period from 34 to 14 percent. The percentage of male AIDS cases attributed to heterosexual contact in 1988 was more than three times that in 1984. If this increase was due only to misclassification of homosexual contact AIDS cases, then at least two-thirds of the male heterosexual contact cases diagnosed in 1988 actually were due to homosexual transmission, so we would expect a diagnosis of KS in at least two-thirds of 14 percent, or about 10 percent, of the male AIDS cases attributed to heterosexual contact diagnosed during 1988. In fact, the percentage of heterosexual contact AIDS cases with KS remained at 5 to 6 percent for cases diagnosed during 1984–87, and was less than 4 percent for cases diagnosed during 1988. Thus KS in men with AIDS attributed to heterosexual transmission resembles the pattern of KS in male IVDUs and male transfusion recipients with AIDS (Table 4) much more than the pattern of KS in male homosexual transmission AIDS cases.

TABLE 4—Percentage of Men with AIDS with a Diagnosis of Kaposi's Sarcoma: Comparison of Reported Heterosexual Contact Cases, and Cases in Other Risk Groups, for Cases Diagnosed during 1984–88

	Percent with Kaposi's Sarcoma			
Year of Diagnosis	Homosexual or Bisexual*	Heterosexual IVDU	Transfusion Recipients	Reported Heterosexual Contact
1984	34.4	4.1	4.9	5.3
1985	28.4	2.9	5.7	6.2
1986	23.0	3.3	4.0	5.3
1987	18.1	2.4	3.6	5.7
1988	14.1	2.6	2.7	3.7

*Not also IVDU

Discussion

Table 1 and Figure 1 might actually understate somewhat the true proportion of AIDS cases resulting from heterosexual transmission in the United States. When AIDS cases initially reported with no identified risk were investigated (including patient reinterviews) by Castro, *et al*, approximately one-fifth were reclassified as attributable to heterosexual transmission.[7] Of cases that remained in this category after follow-up investigations were completed, 38 percent reported a history of sexually transmitted disease, and 34 percent of the men reported contact with female prostitutes. Over 4 percent of AIDS cases diagnosed in 1988 currently are classified in the no identifiable risk category. Thus, heterosexual transmission of HIV probably accounts for close to 5 percent of AIDS cases now being diagnosed in the United States. Furthermore, the hierarchical system of classifying cases may misclassify some heterosexually acquired cases among persons with multiple risk factors for HIV exposure into other risk groups. Extrapolation of present trends suggests that at least 7 percent of adult AIDS cases diagnosed in late 1990 will be classified as reported heterosexual transmission cases (J Karon, unpublished).

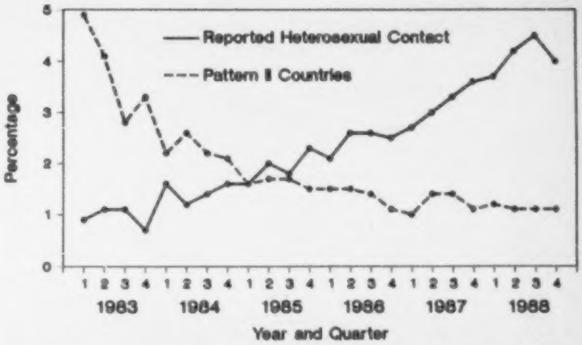

FIGURE 1—Trends in the Percentage of US Cases of AIDS Classified as Heterosexually Acquired, by Quarter of Diagnosis, 1983–88.
Declining trends in the percentage of cases born in WHO Pattern II countries (where heterosexual transmission predominates, such as Haiti and countries in sub-Saharan Africa) are offset by steadily increasing trends in the percentage of remaining US cases of AIDS attributed to reported heterosexual contact with an individual in another risk group for HIV infection or with someone known to have AIDS or HIV infection.

On the other hand, several possible sources of bias could inflate the percentages of cases attributed to reported heterosexual contact, particularly in men. One possible explanation is that the observed trend may be due to a decreasing percentage of cases in homosexual and bisexual men. However, even after excluding all AIDS cases attributed to sexual contact between men (with or without IVDU), the percentage of cases in men attributed to reported heterosexual contact increased from 1.6 percent of the cases diagnosed in 1984–85 to 4.7 percent of the cases diagnosed in 1988. Although male AIDS patients with KS might be questioned more carefully than male AIDS patients without KS about same sex contacts, the data in Table 4 are not consistent with the hypothesis that the increase in male AIDS cases attributed to reported heterosexual contact is due *primarily* to misclassification of homosexual or bisexual men with AIDS. Nevertheless, as heterosexual transmission of HIV has become more widely acknowledged recently, it may have become easier for persons with AIDS to claim heterosexual exposure instead of homosexual contact or IVDU. This might especially be a problem outside the original epicenters. Decreasing likelihood of investigation (because of rising case loads) and recruitment of less experienced interviewers could also account for some of the temporal increase in AIDS cases attributed to heterosexual contact.

Because the source of the HIV infection in most cases attributed to heterosexual contact is reported as an IVDU (Table 3), another indirect assessment of misclassification of these cases is a comparison of the geographic distributions of cases attributed to heterosexual contact and of those attributed to IVDU. The geographic distribution of heterosexual contact cases in women is similar to that of cases in male IVDUs, but there are substantial differences between these distributions for male heterosexual contact cases and female IVDU cases.[8] The ratio of male heterosexual contact cases to female IVDU cases is unusually low in New York and unusually high in Florida. Thus, the direction of any misclassification bias is uncertain. Geographic differences in follow-up of men claiming heterosexual contact as their only risk factor probably causes some of these geographic differences.

The change in the criteria for a reportable AIDS case in September 1987 may affect subsequent trends in the percent of cases attributed to reported heterosexual contact. The criteria were expanded to include both additional diseases and presumptive diagnoses of some opportunistic infections in persons known to be HIV-seropositive.[1] This change affected the percentages of cases in some risk groups, especially homosexual/bisexual men not using IV drugs (a sharp decrease) and heterosexual IVDU (a sharp increase).[9] These changes roughly offset each other in men, resulting in a modest increase in the proportion of cases attributed to reported heterosexual contact: for cases diagnosed during September 1987 through December 1988, this proportion is 1.2 percent (355 of 28,686 cases) diagnosed under the pre-1987 definition and 1.8 percent (199 of 10,894 cases) diagnosed under the expanded criteria. There is a marked effect in the opposite direction among women, with corresponding proportions 30 percent (840 of 2,756 cases diagnosed under the pre-1987 definition) and 22 percent (412 of 1,835 cases diagnosed under the expanded criteria), due to the increase in cases in women using IV drugs reported under the expanded criteria.

The present analysis shows that for AIDS cases reported from 1983 through 1988 and attributed to reported heterosexual contact, the cumulative incidence was much higher in Blacks and Hispanics than in Whites (Table 2). By comparison, for all cases of AIDS reported to CDC through January 18, 1988, Selik, *et al*, reported that the incidence was 2.8 times higher for Black men and 2.7 higher for Hispanic men than for White men; the incidence was 13.2 times higher for Black women and 8.1 times higher for Hispanic women than for White women.[10,11] Among Hispanics, incidence has been higher in those born in Puerto Rico than elsewhere, especially for IVDUs.[12] Thus, among men, the incidence of AIDS attributable to reported heterosexual contact for Blacks and Hispanics, relative to Whites, is higher than the overall risk of AIDS for Blacks and Hispanics, relative to Whites. The racial and ethnic differences in the incidence of AIDS attributed to reported heterosexual contact mirror the racial differences in incidence of AIDS associated with IVDU,[13] as well as differences in incidence of other sexually transmitted diseases (STD) as discussed below.

Further evidence for the importance of heterosexual acquisition of HIV among women comes from an analysis of the mother's exposure category for AIDS cases in children (age < 13 years at diagnosis). Of the 1,176 pediatric AIDS cases diagnosed through 1988 and reported to CDC through June 1989 that were attributable to perinatal transmission of HIV from a mother not born in a Pattern II country, 350 (30 percent) involved children born to mothers whose sex partners were in a risk group for HIV infection or had known HIV infection. Trends in this proportion should be further examined to see if the proportion is increasing over time.

Because of the delay of several years from acquisition of HIV until onset of AIDS, the increasing percentage of cases of AIDS seen now that are attributable to reported heterosexual contact actually reflects increasing trends in heterosexual transmission of HIV that were occurring several years ago. Data are not yet available concerning the current percentage of new HIV infections in the United States that are attributable to heterosexual acquisition, but there is a growing body of information about the prevalence of HIV in various nonrandom samples of populations that were not selected for specific high-risk behaviors.

For example, among US military applicants the overall prevalence of HIV seropositivity from October 1985 through March 1988 was 1.2 per 1,000, and was related to age, sex, race, and geographic area.[14,15] Male sex, Black race, and residence in a metropolitan area with a high incidence of AIDS were associated with the highest rates of HIV seropositivity. Seroprevalence rates exceeding 1 percent were observed in six counties in New York, New Jersey, California, and the District of Columbia. In future surveys, to assess further the role of heterosexual transmission in comparison with the role of other risk factors, it will be important to attempt representative sampling, and to conduct reinterviews of seropositive heterosexual persons.

So far, prostitution and sex with prostitutes have been implicated as important in the heterosexual transmission of HIV mainly in Pattern II countries.[2,16–19] Nonetheless, the history of prostitute contact among 34 percent of US male patients classified as having no identified risk[7] dictates that this issue be examined closely in the future. Other specific risk factors for heterosexual transmission include receptive anal intercourse for women[20] and immunosuppression in the source contact.[21] In Africa, genital ulcer disease[22–25] and lack of male circumcision[23,25] have been repeatedly implicated as cofactors associated with heterosexual transmission. Other sexually transmitted infections such as cervical chlamydial infection,[24] vaginal trichomoniasis,[26] and current oral contraceptive use[24] have been implicated as risk factors for heterosexual acquisition of HIV in single studies and require confirmation in other studies. Condom use has been associated with reduced risk of heterosexual transmission of HIV.[27–29]

Much remains to be learned about the epidemiology of heterosexually transmitted HIV infection in industrialized countries. However, the fact that HIV seropositivity among heterosexuals in the United States is associated with urban residence and certain racial minorities should not be automatically attributed solely to patterns of distribution of IVDU, since these associations also parallel the epidemiology of other heterosexually transmitted infections in North America. In the United States the reported incidence of other sexually transmitted diseases, such as gonorrhea, like the incidence of heterosexually acquired AIDS, is highest for persons of lowest socioeconomic status, higher for urban dwellers than for those living in the suburbs or rural areas, and much higher for Blacks and Hispanics than for Whites and Asians.[30] For example, during 1988 in the United States, the incidence of reported cases of gonorrhea was approximately 21 times higher in Black than in White women.[30]

Reporting of syphilis is considered to be more complete than reporting of gonorrhea. During 1987, the incidence rates of reported early syphilis in the United States were 25 times higher in Black men and 12 times higher in Hispanic men than in White men; the incidence was 31-fold higher in Black women and 8-fold higher in Hispanic women than in White women.[31] Chancroid, another sexually transmitted disease that has been increasing recently in incidence in the United States, has also occurred predominantly among Blacks and Hispanics, often in association with prostitution.[32]

It is evident that at least four phenomena in inner-city indigent populations could interact to promote heterosexual spread of HIV in the United States.[30] These include: 1) the pattern of sexual behavior, including early onset of sexual intercourse, prostitution, and sex with prostitutes; 2) epidemic spread in these populations of sexually transmitted diseases, including genital ulcer disease, which themselves may promote heterosexual spread of HIV; 3) transmission of HIV by IVDU; and 4) increasing use of drugs such as crack cocaine, which promotes high-risk sexual behavior, including traditional forms of prostitution and exchange of sex for drugs—a form of prostitution often involving teen-agers. Promotion of "safe sex" practices will be especially difficult in this group.

Culturally sensitive, age-specific social and health educational programs, endorsed by community leaders and beginning in early adolescence, if not sooner, are urgently needed to interrupt the heterosexual spread of HIV. These should be accompanied by programs to better control other STDs as risk factors for HIV transmission, and by programs to prevent and curtail illicit drug use.

APPENDIX

Risk Groups for AIDS/HIV Transmission

In the CDC hierarchical definition of risk group, a person with AIDS who reports sexual contact with a member of the same sex (if male), receipt of clotting factors, or IVDU will not be classified as having AIDS due to heterosexual transmission. In the absence of these risk behaviors, a person classified as having AIDS due to heterosexual transmission must either report heterosexual contact with a person known to be infected or at risk for infection (i.e., someone in one of the above risk groups, an HIV-infected transfusion recipient, or a person born in a Caribbean or African country designated by the World Health Organization as "Pattern II"). Nearly all people in the United States with reported AIDS attributed to heterosexual transmission who were born in these countries were born in Haiti (1,233 of 1,253). A person with AIDS reporting heterosexual contact with a prostitute but no other risk factor is classified as having no identified risk, not as a heterosexual transmission case.

As a result of the hierarchical classification, some cases attributed to other exposures (especially IVDU) could actually have resulted from heterosexual contact. Follow-up has shown that some cases initially classified as having no identified risk actually resulted from heterosexual exposure.[7] Of course, some cases designated as "reported heterosexual contact" may have other risk factors, such as unreported homosexual contact or IVDU.

For each AIDS case, the surveillance data include the diseases recorded at the time of diagnosis, but additional diseases that develop later are not necessarily reported. This could affect time trends of the percent of cases with a disease, such as Kaposi's sarcoma (KS). For example, if wasting syndrome tends to develop earlier in the course of HIV disease than KS, the addition of wasting syndrome to the AIDS surveillance definition in 1987 would tend to decrease the percent of reported cases with KS.

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New NCHS Report Summarizes 1987 Divorce Statistics

The National Center for Health Statistics has issued a new report giving the final United States divorce data for 1987, and showing that the divorce rate (for 1,166,000 divorces) dropped 1 percent from the previous year, and was down 4 percent from the record high of 1,213,000 reached in 1981. Several measures of divorce have declined to levels of the 1970s:

- The divorce rate for 1987 was 4.8 per 1,000 population; provisional data for 1989 show a further decline to 4.7.
- The number of children involved in divorce was 1,038,000 in 1987, fewer than in any year since 1973 and reflecting both the declining number of divorces and the shrinking size of American families.

In other findings, the study reported that:

- 52 percent of divorcing couples had children under 18 years of age.
- 12 percent of those married less than a year had children, as did 26 percent of those married 1–2 years; 42 percent of those married 3–4 years; 60 percent of those married 5–9 years, and 75 percent of those married 10–14 years.
- Divorcing men and women who were college graduates had fewer minor children than couples with less education.
- Husbands and wives divorcing in 1987 were older than their counterparts in any year since 1970, reflecting longer durations of first marriages and marrying at older ages.
- For both sexes, divorce in 1987 is concentrated between 20 and 45 years of age: 81 percent of husbands and 87 percent of wives were under age 45; only 3 percent of husbands and 2 percent of wives were age 60 or over.
- In 1987, 72 percent of divorces were ending first marriages, 21 percent ending second marriages, and 7 percent ending third or higher order marriages. The average age of men ending first marriages was 34.6 years. Typically, women were 2–4 years younger, depending on the number of times they were married.

The summary report is published by NCHS as *Advance report of final divorce statistics, 1987,* in Monthly Vital Statistics Report 1990;38(12), suppl 2. Hyattsville, MD, USPHS. The full report will be published in *Vital Statistics of the United States, Vol III—Marriage and Divorce*. For further information, contact Sandra Smith, Public Affairs Officer, NCHS, (301) 436-7135, or Barbara Foley Wilson, Demographer, (301) 436-8977.

Public Health Briefs

Patient 'Dumping' Post-COBRA

ARTHUR L. KELLERMANN, MD, MPH, AND BELA B. HACKMAN, MD

Abstract: To gauge the impact of the new federal patient transfer provisions following the federal Combined Budget Reconciliation Act of 1985 (COBRA), we monitored all emergency interhospital transfers to a public hospital emergency department in the Memphis, Tennessee area during three identical time periods: June 1 to August 31 of 1986, 1987, and 1988. A high number of transfers in the summer of 1986 diminished only slightly in summer 1987 (following implementation of COBRA). Far greater reductions occurred in summer 1988, when overcrowding forced our hospital to refuse most transfers. In contrast to changes in hospital policy, COBRA alone had little effect in this area. (*Am J Public Health* 1990; 80:864–867.)

Introduction

On August 1, 1986 the patient transfer provisions of the federal Combined Budget Reconciliation Act of 1985 (COBRA) became law.[1] Under COBRA, hospitals receiving Medicare funds are required to take certain steps prior to transferring unstable patients or women in active labor. Although COBRA is primarily intended to stop the inappropriate transfer of unstable patients for economic reasons (a practice known as patient "dumping"), the impact of this law is unclear.[2] To study the effect of COBRA in our community, we identified all patients transferred to our public hospital emergency department during the summer months of 1986, 1987, and 1988.

Methods

Shelby County, Tennessee contains the city of Memphis (1985 population 635,000) and is surrounded by rural west Tennessee, northern Mississippi, and eastern Arkansas. The county's population is 54.5 percent White and 44.5 percent Black, with small Asian and Hispanic minorities. One of 10 general hospitals in the county, the Regional Medical Center at Memphis receives an annual operating subsidy from Shelby County government to treat county residents who otherwise cannot afford care. No other hospital for adults in Shelby County receives county funds.[3]

During each of three study intervals, June 1–August 31 of 1986, 1987, and 1988, we identified all patients transferred to the Medical Center Emergency Department from area hospital emergency departments or their affiliated freestanding emergency centers. Patients sent directly to one of the Medical Center's special care units (Level 1 Trauma Center, Burn Unit, and High-Risk Obstetric Service) were assumed to represent tertiary care referrals and were excluded.

Transfers were considered "authorized" if the sending facility contacted a physician at the Medical Center who accepted the patient prior to transfer. Patients sent without prior notification, patients sent despite the Medical Center's refusal to accept the transfer, and patients in route prior to the transfer request were considered to be "unauthorized." Transfers were judged to have been made for primarily economic reasons when "no money" or "Shelby County indigent" was explicitly identified by the sending physician as the primary reason for transfer or no specific reason for transfer was recorded but the patient lacked private insurance, Medicare, or Medicaid. Unstable patients were identified by three independent reviewers who compared each patient's chart to a previously published[3] list of explicit criteria (see Appendix). Only patients meeting one or more criteria in the judgment of all three reviewers were considered to be unstable at the time of transfer.

COBRA became law on August 1, 1986 but no immediate changes in local hospital policy occurred at that time. However, in October 1986, local news stories[4-6] and subsequent state[7] and federal[8] hearings focused increasing attention on patient "dumping." Telephone screening of transfer requests was also intensified, but our long-standing practice of accepting indigent patients deemed "stable" for transfer did not change. Although hospital over-crowding intermittently required us to restrict interhospital transfers during 1986 and 1987, these intervals were generally brief. By the summer of 1988, however, overcrowding became so severe that the Medical Center Emergency Department (ED) was repeatedly forced to restrict authorization of interhospital transfers for days at a time. No other major changes in health policy occurred in Memphis during this time (Table 1).

TABLE 1—Study Interval Characteristics

	Summer 1986	Summer 1987	Summer 1988
Time Interval	92 days	92 days	92 days
Total ED Visits	15,617	17,355	18,220
COBRA in Effect?	No*	Yes	Yes
Hospital Crowding	Moderate	Moderate	Severe
Total Days Transfers to Medical Center ED Restricted**	31 days	36 days	65 days

*COBRA implemented 8/1/86; law not widely recognized until fall of 1986.
**Authorizations restricted all or part of a calendar day.

From the Divisions of Emergency Medicine (Kellermann) and Cardiology (Hackman), Department of Medicine, University of Tennessee. Address reprint requests to Arthur L. Kellermann, MD, MPH, Division of Emergency Medicine, Department of Medicine, University of Tennessee, 877 Jefferson, Room G071, Memphis, TN 38103. This paper, submitted to the Journal June 28, 1989, was revised and accepted for publication November 9, 1989.

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Results

During summer 1986, 266 patients were transferred to the Medical Center ED, 243 of which (91 percent) were sent for primarily economic reasons. Somewhat fewer patients (N = 226) were transferred during summer 1987, (when COBRA was in full effect), but the proportion sent for primarily economic reasons did not change. Under the severely overcrowded conditions of summer 1988, total interhospital transfers declined precipitously (N = 85), but the proportion sent for primarily economic reasons remained the same (92 percent).

More than half of patients transferred during the summer of 1986 were unauthorized, including four sent despite refusal by the Medical Center. During summer of 1987 (post COBRA) unauthorized transfers declined by only 18 percent, but 10 patients were sent despite refusal by the Medical Center. During summer 1988, unauthorized transfers declined by fully 61 percent compared to 1986; five transfers arrived despite prior refusal by the Medical Center (Figure 1).

COBRA is intended to stop the inappropriate transfer of unstable patients, particularly when transfer is being accomplished for primarily economic reasons.[2] Based on explicit criteria, 64 of 243 patients (26 percent) transferred to the Medical Center primarily for economic reasons during the summer of 1986 were determined to be unstable. Two of every three had been accepted as "stable for transfer" on the basis of telephone assurances by the sending physician.[3] Unstable economic transfers fell modestly in the summer of 1987 (N = 46) and declined sharply in summer 1988 (N = 13) but the proportion sent without advance authorization did not change. Virtually identical numbers of economic transfers required emergency hospitalization during the summers of 1986 and 1987, and the number requiring emergency surgery and/or intensive care actually increased. Both total admissions and total critical care cases fell sharply during the summer of 1988 (Figure 2). Seven transferred patients died prior to hospital discharge during one of the three study periods: three in summer 1986, three in summer 1987, and one in summer 1988. None of these had been sent without advance authorization by the Medical Center.

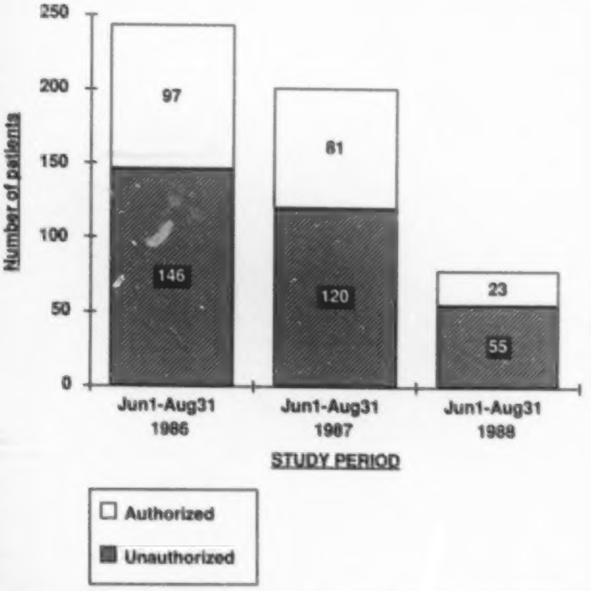

FIGURE 1—Authorized vs Unauthorized Economic Transfers to Memphis Medical Center, Summer 1986, 1987, 1988

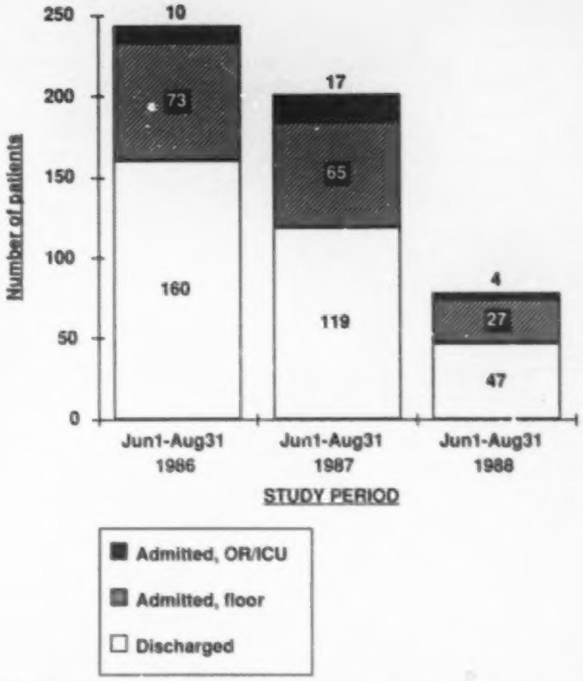

FIGURE 2—Disposition of Economic Transfers Made to Memphis Medical Center Emergency Department, Summer 1986, 1987, 1988

Discussion

In 1988, an audit by the Office of Inspector General for the Health Care Financing Administration found that record keeping at most sending hospitals is inadequate to monitor patient transfers in general, much less to screen for "dumping," and that few receiving hospitals have a procedure for identifying potential violations of COBRA. With no effective mechanism for monitoring transfers, the report concluded that ". . . the ability of HHS (Department of Health and Human Services) to monitor and oversee this (dumping) problem is jeopardized. . ."[9]

By documenting interhospital transfers to a single public hospital, we were able to study community practice before and after implementation of COBRA. Explicit criteria were devised and consistently applied throughout each of three identical study intervals. Definitions of "unstable cases" and "economic transfers" were narrowly drawn. As a result, our case totals are almost certainly conservative. For example, all obstetric, burn, and trauma center transfers were presumed to represent tertiary care referrals, even when the patient was indigent and his or her problem could have been easily managed at the original hospital.

Four limitations to our study warrant comment. First, given the case mix of our emergency department, we cannot address COBRA's impact on transfers of children or of women in labor. Second, our data are based on temporal associations between changes in national (and local) health care policy and changes in the number and types of patients transferred to our emergency department. Although no major changes to Shelby County's health care system occurred during the time period studied, we cannot exclude possible effects of other, unidentified factors. Third, without access to the charts of indigent patients seen at other hospitals, we cannot judge whether they were better or worse off when transfers to our hospital were restricted. We believe that most who would otherwise have been transferred to the Medical Center were either admitted or adequately treated at the original hospital, since few found their way to our emergency department the following day. Finally, our conclusions are based on transfers to a single public hospital. They may not reflect COBRA's effect on patient "dumping" in other cities or states.

In an era of intense health care competition, the pressure on private hospitals to transfer non-paying patients to public facilities is great. We found that COBRA alone had little impact on the magnitude or nature of patient "dumping" in Memphis. Substantial reductions in total economic transfers did not occur until the Medical Center began to sharply restrict authorizations due to overcrowding. The role COBRA may have played in limiting the number of unauthorized transfers during this latter time period is unclear.

Caught between concerns about patient dumping and the need to maintain cordial multi-institutional relationships, public hospital officials are reluctant to address potential violations of COBRA.[9,10] Recently HCFA proposed stiff penalties for receiving hospitals that fail to report suspected cases of dumping.[11] Our data suggest such measures may be needed. As currently written, the impact of COBRA appears to be slight.

APPENDIX
Severity of Illness Criteria (noted at time of arrival in receiving emergency department)

Vital Signs

a) Heart rate >140 or <50 beats per minute
b) Respiratory rate >28 or <8 breaths per minute
c) BP Diastolic <40 or >130 mm Hg
d) Temperature <94 or >102 degrees fahrenheit

Cardiovascular

a) Chest pain with suspicion of ischemia
b) Rhythm: supraventricular tachycardia with heart rate ≥ 149 heart block (second degree mobitz II or greater), ventricular tachycardia or high grade ectopy
c) IV antiarrhythmics or IV pressors (eg, dopamine, dobutamine, norepinephrine, lidocaine, procainamide, bretyllium) during transport

Respiratory

a) Hypoxia ($PO2 \leq 60$ mm Hg regardless of FIO2)
b) Intubated prior to transfer
c) Noted to be in "respiratory distress" or "respiratory failure"
d) Airway obstruction with stridor
e) Respiratory acidosis (pH <7.30 with pCO2 >50 mg Hg)

Infections

a) Meningitis (suspected or diagnosed)
b) Sepsis (suspected or diagnosed)
c) Active infection in an immunocompromised hosts. (cancer patients, leukemia, AIDS)

Shock

a) BP <100, with tachycardia ($P \geq 100$), and/or other findings of hypoperfusion: (i.e., decreased mentation, cool extremities, dusky extremities, evidence of organ dysfunction)

Metabolic

a) Diabetic ketroacidosis (pH <7.30, HCO3 <14 mmol/l with glucose >200 mg/dl and ketonuria)
b) Hypoglycemia (BG <40 mg/dl with mental status change)
c) Hyperglycemia: (BG >800 mg/dl)
d) Potassium ≤ 3.0 or ≥ 6.0 meq/L
e) Acidosis (pH <7.30) (any cause)
f) Drug toxicity (Digoxin level >2.0 ng/ml, theophylline >20.0 mg/ml Phenytoin level >30.0 mg/ml, Lithium >2.0 mmol/l, drug screen positive of tricyclic antidepressants with suspicion of overdose)
g) Sodium >150 meq/l or <125 meq/l

Neurologic

a) Altered mental status (lethargic, confused, comatose, unable to answer questions)
b) New focal neurologic deficit(s) (all causes)

Ob/Gyn

a) Suspected ectopic pregnancy with pain and/or bleeding

Hematology

a) Severe anemia (hematocrit $<25\%$ with evidence of acute blood loss per nasogastric tube or hematemesis, rectal bleeding, and/or vaginal bleeding)
b) Required blood transfusion during or prior to transport
c) Active blood loss upon arrival of >500 cc with evidence of shock regardless of hematocrit

Gastroenterology

a) Active upper/lower GI bleeding
b) Possible acute abdomen (abdominal tenderness, with signs of acute peritonitis) or pancreatitis

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Serious Poisonings among Older Adults: A Study of Hospitalization and Mortality Rates in Massachusetts 1983–85

3T

ALAN WOOLF, MD, MPH, SUSAN FISH, PHARMD, CAREY AZZARA, MA, AND DEBORAH DEAN, MSPH

Abstract: We analyzed poisoning-related hospitalization and mortality rates among older adults living in Massachusetts during 1983–85. While poisoning-related hospitalization rates of individuals ≥60 years were near the state average, death rates for men ≥70 years and for women over 60 were higher than those of younger individuals. Medications and carbon monoxide were commonly implicated agents in these poisoning deaths. Older adults are more vulnerable to death from a poisoning than are younger age groups. (*Am J Public Health* 1990; 80:867–869.)

Introduction

The incidence of serious poisonings among older individuals is poorly documented. The purpose of this study was to determine poisoning hospitalization and death rates among older people in Massachusetts, and to compare such rates with those of younger age groups in order to assess relative risk.

Methods

The Massachusetts Uniform Hospital Discharge Data Set (UHDDS) contains all hospital discharges recorded by 108 acute care institutions within the state. Data from 1983–85 were scanned for principal discharge diagnoses recorded as poisonings or adverse effects of chemicals or drugs. The International Classification of Diseases, 9th edition, Clinical Modification (ICD-9-CM) diagnosis codes used in the analysis are shown in the Appendix. Data were aggregated by five-year age intervals and sex. Death certificates for 1983–85 constituted our second data set. A death was counted as due to poisoning if either the underlying cause of death or any mentioned cause was listed as a poisoning or adverse effect of a drug or chemical. Rates were calculated based on population estimates for 1985 made by the Massachusetts Institute for Social and Economic Research.[1] Hospitalizations and deaths due to the acute or chronic effects of alcoholism were specifically excluded. Age- and sex-specific poisoning-related hospitalization rates and death rates were calculated and compared with mean statewide rates.

Results

Hospitalization

There were 17,805 hospitalizations in Massachusetts during 1983–85 in which a poisoning or the toxic effect of a drug or chemical was the principal discharge diagnosis; 2,200 of these involved persons 60 or more years of age. Almost 81 percent (N = 1778) of the hospitalizations of persons 60 or more years of age were associated with exposures to medications; household products were implicated in 301 (13.7 percent); plant exposures, animal stings or envenomations were implicated in 121 (5.5 percent). The poisoning hospitalization rates and 95% confidence intervals for both males and females in all age groups between 60–79 years were below the state average for persons under age 60 (Table 1). The poisoning hospitalization rates for males age 80 and older were higher than the state average for males under age 60.

Deaths

There were 1,116 deaths attributable to poisonings or toxic effects recorded in Massachusetts during the years 1983–85, including 136 male and 139 female deaths of persons 60 or more years of age. Death rates from poisoning for males 70 or more years of age and for females 60 or more years of age were substantially higher than the sex-specific state rates

TABLE 1—Annualized Poisoning Hospitalization Rates and Relative Risks,* Massachusetts 1983–85

Age Groups (years)	Males (Hosp/10^5/Yr)	RR* (95% CI)	Females (Hosp/10^5/Yr)	RR* (95% CI)
60–64	44	.47 (.40, .55)	58	.47 (.42, .53)
65–69	57	.61 (.52, .70)	64	.52 (.46, .58)
70–74	58	.62 (.52, .73)	74	.60 (.52, .67)
75–79	64	.68 (.56, .83)	91	.73 (.65, .83)
80–84	116	1.23 (1.01, 1.50)	102	.82 (.72, .95)
85+	112	1.19 (.94, 1.51)	96	.77 (.67, .89)
State Average (all ages)	89		114	
State Average (persons less than 60 years old)	94		124	

*RR = Relative Risk (Age Specific Rate/State Average Rate [<60 yr]). 95% confidence intervals in parentheses.

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for persons under 60 years of age with relative risks increasing directly with age (Table 2).

For 152 of the original 275 poisoning-related deaths of persons 60 or more years of age, E-coded data were available enabling assessment of intentionality (Table 3). For both males and females, drugs were the most important agent of accidental (unintentional) death. Carbon monoxide was a common cause of intentional (suicidal) poisoning-related death in males but drugs predominated among females.

Discussion

Seniors might be considered to be at a higher risk for a serious poisoning incident than adults in younger age groups for a variety of reasons. While the elderly comprise just 12 percent of the total population, they consume 31 percent of all prescription medications.[2] It is common for elders to be taking multiple medications simultaneously.[3-6] Many have underlying heart, liver, kidney, or lung diseases, any of which might complicate an overdose situation or affect the pharmacokinetics of a drug or toxin.[7-9] Also, 2–4 million older Americans suffer from dementia[10]; such patients may be confused and have difficulty complying with complicated dosage regimens. Failing eyesight and memory may be responsible for medication errors or for mistaking household products as potables. Finally, the elderly are at risk for depression[11] and may take overdoses in suicide attempts.

Previous analyses of calls to Poison Control have concluded that the poisoned elderly are more likely to be admitted to the hospital and are more likely to die from the poisoning than are younger age groups.[12,13] However small numbers of subjects, a lack of population-based denominators, and an acknowledged reporting bias raise questions regarding the validity of such findings. The current study suggests that hospitalization rates for poisoning among older adults are not very different from those of younger age groups. However, our results support the conclusion that both elderly males and females are at greater risk of poisoning-related death than younger persons. That older individuals are more vulnerable to a terminal outcome from a poisoning episode reinforces the speculation that they are more fragile to the toxic effects of drugs and poisons than are younger individuals. Also, E-coding analysis suggests suicide to be a prominent cause of poisoning death among the elderly. These two factors, vulnerability and intentionality, are important considerations for both clinicians and researchers studying poisoning in this age group.

TABLE 2—Annualized Poisoning-Related Death Rates and Relative Risks,* Massachusetts 1983–85

Age Group (years)	Males (Deaths/ 10^5/Yr)	RR* (95% CI)	Females (Deaths/ 10^5/Yr)	RR* (95% CI)
60–64	8.34	1.04 (.73, 1.48)	6.62	1.74 (1.20, 2.22)
65–69	7.45	0.93 (.62, 1.40)	7.04	1.85 (1.26, 2.70)
70–74	14.43	1.80 (1.27, 2.55)	5.68	1.49 (.95, 2.34)
75–79	13.07	1.63 (1.04, 2.55)	7.79	2.04 (1.32, 3.15)
80–84	14.00	1.75 (.99, 3.09)	6.07	1.59 (.89, 2.84)
85+	20.54	2.56 (1.48, 4.44)	13.07	3.43 (2.28, 5.16)
State Average (all ages)	9.37		5.16	
State Average (persons less than 60 years old)	8.02		3.81	

*RR = Relative Risk (Age Specific Rate/State Average [<60 yr]). 95% confidence intervals in parentheses.

TABLE 3—Intentionality and Agent of Poisoning Deaths in Massachusetts Adults 60 Years and Older, 1983–85*

	Sex	
Circumstance/Intentionality	Male N = 74	Female N = 78
Accidental/Unintentional		
Drugs	20	26
Carbon Monoxide	5	5
Isopropanol	1	0
Benzene	1	0
Subtotal	27	31
Indeterminate		
Drugs	3	9
Suicide/Intentional		
Drugs	9	32
Carbon Monoxide	31	6
Corrosive	1	0
Carbon Tetrachloride	1	0
Other Agents	2	0
Subtotal	44	38

*Table includes only those deaths for which E-codes were available (152 out of 275 total deaths).

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APPENDIX

ICD 9-CM Diagnosis Codes Used in Dataset Analysis

960-979.9	Poisonings by drugs, medicinal and biological substances
980-989.9	Adverse effects of drugs
E850-E858.9	Accidental poisoning by drugs, medicinal substances, and biologicals
E860-E869.9	Accidental poisonings by other solid and liquid substances, gases, and vapors
E950-E952.9	Suicide and self-inflicted poisoning
E962.0	Assault by poisoning
E980-E980.5	Injury undetermined whether accidentally or purposefully inflicted by poisoning

(E coding refers to the ~~circumstances under~~ which poisoning or injury occurs)

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Changes in Ambulatory Surgery Utilization 1983–88: A Community-Based Analysis

37

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Abstract: Changes in ambulatory surgery utilization in the metropolitan area of Syracuse, New York 1983–88 were identified. Total ambulatory surgery utilization rose from 12,479 to 24,643 procedures. Approximately 69 percent of the increase was generated by freestanding surgery centers. Operations responsible for the largest additional volumes included lens procedures, certain cervical procedures, hernias, and excision of skin and breast lesions. (*Am J Public Health* 1990; 80:869–871.)

Introduction

Ambulatory surgery is usually defined as procedures which are more complicated than those carried out in physicians' offices but less complex than those which necessitate inpatient hospital stays.[1] In the United States, the availability and utilization of ambulatory surgery have increased considerably during the past two decades.[2] By 1988, 964 freestanding surgery centers were operating in the nation, and hundreds of hospitals performed selected procedures on an outpatient basis.[3,4] Between 1983 and 1988, ambulatory surgery utilization nationwide increased from approximately 5,000,000 to about 13,735,000 procedures.[4,5] It has been reported that physicians no longer have to be convinced to use ambulatory surgery, they insist on it.[6]

Changes in the health care marketplace have also encouraged the growth of ambulatory surgery. The introduction of prospective payment approaches by Medicare and other payors has focused on reduction of hospital stays. Medicare now requires that certain eye procedures be performed in outpatient settings. Reductions in inpatient utilization, brought about by these mechanisms, have encouraged hospitals to compete in a variety of settings, including ambulatory care.[2,7,8]

Evaluation of the growth of ambulatory surgery has been made difficult by the lack of consistent, longitudinal data concerning this modality.[9] The present study evaluated developments in ambulatory surgery in the metropolitan area of Syracuse, New York between 1983 and 1988 to follow up earlier reports.[10,11]

The health care system of Syracuse, New York has made extensive use of ambulatory surgery because of the limited supply of acute care beds in the area (2.9 per 1,000 population compared with 4.1/1,000 population nationally).[12,13] During 1983, four ambulatory surgery programs existed in Syracuse. One of these programs was freestanding operated by a hospital (including four operating rooms), the others were hospital-integrated (using existing institutional operating rooms and support services). Between 1983 and 1988, two additional freestanding programs were opened in Syracuse. One of these was an additional program operated by Crouse Irving Memorial Hospital, the other was established by a group of local physicians.

Methods

This study identified changes in ambulatory surgery utilization in Syracuse between 1983 and 1988 at the aggregate and procedure-specific levels. Aggregate data for ambulatory surgery were obtained from the hospitals. Procedure-specific data were collected from two hospitals, Crouse Irving Memorial Hospital and St. Joseph's Hospital Health Center, which maintained such information for both years. Inpatient data for the same procedures were obtained from New York's Statewide Planning and Research Cooperative System.

Results

Between 1980 and 1987, the rate of inpatient surgical operations per 1,000 population in the United States declined from 78.1 to 76.4.[14] The data in Table 1 demonstrate that, between 1983 and 1987, discharges of surgical patients per 1,000 population declined in all six of New York State's major metropolitan areas. The largest decline (16.0 discharges per 1,000 population or 25.4 percent of the 1983 level) was produced in Binghamton. Syracuse, which in 1983 had a rate lower than all of the other areas, was able to reduce that rate by 10 percent within a five-year period.

The data in Table 2 indicate that the total procedures performed in ambulatory surgery programs in Syracuse increased by 97.5 percent during the five-year period. This was paralleled by an estimated 150 percent increase at the national level.[8,4] The total ambulatory procedures performed in Syracuse during 1988 (24,643) exceeded the number of

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TABLE 1—Resident Surgical Discharges per 1,000 Population, New York State Metropolitan Areas, 1983–87

Metropolitan Area	Surgical Discharges per 1,000 Population	
	1983	1987
Albany (Albany County)	56.3	41.6
Binghamton (Broome County)	62.9	46.9
Buffalo (Erie County)	67.1	52.9
New York City	60.1	51.9
Rochester (Monroe County)	48.1	43.5
Syracuse (Onondaga County)	45.4	40.5

Sources: New York State Department of Commerce, Economic Development Board, Population Projections—February 14, 1983 (identified through linear interpolation of 1980 U.S. Census data and April 1985 New York State Department of Commerce Population Projections); New York Statewide Planning and Research Cooperative System.

TABLE 2—Ambulatory Surgery Utilization, Syracuse, New York, 1983–88

Facility	Ambulatory Surgery Procedures		
	1983	1988	Percentage Increase
Community-General Hospital	1,519	3,223	112.2
Crouse Irving Memorial Hospital Total	8,104	12,699	56.7
(Irving Avenue Site)	(8,104)	(8,646)	
(Madison-Irving Site)	(0)	(4,053)	
St. Joseph's Hospital Health Center	2,118	2,895	36.7
University Hospital of the SUNY Health Science Center at Syracuse	738	2,081	182.0
Harrison Center	0	3,746	—
Total	12,479	24,644	97.5

principal inpatient operations performed in hospitals (19,075).

Increased use of ambulatory surgery in Syracuse reflected developments at most programs in the community. Freestanding centers operated by Crouse Irving Memorial Hospital and Harrison Center accounted for 68.6 percent of the total increase of 12,164 procedures. Utilization of the hospital integrated programs operated by Community-General Hospital, St. Joseph's Hospital Health Center, and University Hospital also increased, but absolute changes in volume at these facilities were smaller.

Detailed diagnostic data are available for 1983 and 1988 only for procedures performed at the freestanding program operated by Crouse Irving Memorial Hospital and the hospital integrated program managed by St. Joseph's Hospital Health Center.

The freestanding model at Crouse Irving Memorial Hospital was able to generate greater volumes of individual ambulatory surgery procedures. Most of the specific procedures carried out at this hospital were performed in the freestanding model rather than on an inpatient basis (data available on request to authors). With the exception of rhinoplasties and inguinal hernia repairs, more than 90 percent of all of the procedures identified in Table 3 were performed at Crouse Irving Memorial Hospital on an outpatient basis. It was also notable that the percentage of rhinoplasties carried out on an outpatient basis increased from 28 to 81 and the percent of inguinal hernia repairs rose from 49 to 68. These procedures have proven to be useful indicators of the extent of ambulatory surgery utilization.

The hospital-integrated program at St. Joseph's was also able to increase ambulatory surgery volumes but, at the absolute level, these increases were considerably smaller than those which occurred in the freestanding program. By comparison, in 1988, approximately 80 percent of rhinoplasties and 12 percent of inguinal hernia repairs at this hospital were being performed on an outpatient basis. These trends have caused St. Joseph's Hospital Health Center to plan the development of its own freestanding program.

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TABLE 3—Ambulatory Surgery Utilization* for Selected Procedures, Crouse Irving Memorial Hospital, St. Joseph's Hospital Health Center, 1983–88

Procedure	Crouse Irving Memorial Hospital		St. Joseph's Hospital Health Center	
	1983	1988	1983	1988
Neurological, Eye, Otolaryngologic				
Carpal Tunnel Release (04.43)	194	262	70	170
Lens Extraction (13.1–13.6)	207	2,238	78	355
Rhinoplasty (21.8)	34	90	79	38
Tonsillectomy, Adenoidectomy (28.2–28.3)	495	582	262	137
Gynecological				
Bilateral Destruction of Fallopian Tubes (66.2)	469	489	0	0
D&C other than Termination of Pregnancy (69.02–69.09)	1,309	1,738	214	273
Excision of Lesion of Vulva, Perineum (71.0–71.11, 71.2–71.4)	65	150	11	20
Other Procedures				
Repair of Inguinal Hernia (53.0–53.1)	240	421	26	35
Incision and Division of Muscle, Tendon, Fascia, Bursa (82.0, 83.0–83.1)	100	78	73	18
Local Excision or Destruction of Breast Lesion (85.11–85.12, 85.20–85.23)	114	474	55	218
Local Excision or Destruction of Lesion Skin, Subcutaneous Tissue (86.11, 86.3)	402	608	78	120
Laparoscopy Except for Destruction, Fallopian Tubes (54.21)	112	597	28	23

*Indicates percent of hospital total (inpatient and outpatient) performed on an outpatient basis.

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Hip Fracture Incidence among the Old and Very Old: A Population-Based Study of 745,435 Cases

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Abstract: Data were obtained from the Health Care Financing Administration and the Department of Veterans Affairs (formerly called Veterans Administration) on all hospital discharges among the elderly population from 1984 through 1987 and combined with census estimates to calculate incidence rates of hip fracture for the elderly population of the United States. Rates for White women were the highest, reaching 35.4 per 1,000 per year among 95 year-olds. Comparably, White men, Black women, and Black men experienced similar age-related increases in risk, although of less magnitude and relatively less rate of change, respectively. (*Am J Public Health* 1990; 80:871–873.)

Introduction

Hip fractures are an important cause of the morbidity and mortality experienced by the elderly population in the United States.[1] Despite this, there have been relatively few national population-based studies of the incidence of hip fracture in this country. Of those previous studies, most have produced unstable estimates of incidence rates for non-Whites (due to small sample sizes)[2,3] or the oldest old (over 85 years of age).[2–7] The present study uses newly available data from the Health Care Financing Administration (HCFA) and the Department of Veterans Affairs (VA) to provide detailed estimates of the incidence of hip fracture in the elderly by age, race, and sex.

Methods

Data were obtained from HCFA on all 40 million short-stay hospital discharges for the calendar years 1984 through 1987 and 4 million discharges from VA hospitals. HCFA requires all institutional providers to submit a uniform billing form that contains the following data: age, race, sex, a maximum of five ICD9-CM diagnostic categories, date of admission and discharge, and a unique patient identifier. VA maintains a similar database, keyed by the same patient identifier.

Cases of hip fracture were identified by scanning the 44 million discharge records for a discharge diagnosis of fracture of the hip (ICD9-CM 820.0 through 820.9) in any of the five diagnostic fields. Patients were excluded if: 1) age at admission was less than 65 years; 2) the fracture could have been attributed to a neoplastic process; 3) the patient had been discharged previously for fracture of the hip in the four-year period; 4) the first discharge diagnosis was for late effects of fracture; or 5) the patient resided outside of Puerto Rico or the United States proper. The remaining cases were considered to be first fractures of the hip and thus comprised the numerator for the calculation of rates.

Denominator information was obtained from the Bureau of the Census for 1985. Incidence rates were calculated as the average annual age-, race-, and sex-specific number of cases divided by the population at risk. Rates were adjusted for one-year age groups using the direct method, with the entire United States population aged 65 years and older serving as the standard.[8]

Results

During the period of 1984 through 1987, 810,949 hospital discharges for fracture of the hip were recorded by HCFA and 11,435 were recorded by VA for persons over 65 years of age. Of these, 54,055 were second fractures or rehospitalizations for a previous hip fracture. An additional 19,899 cases were persons under the age of 65 from the HCFA database, and 4,504 cases were discharged for late effects or attributable to neoplastic processes. The final number of eligible incident cases of first hip fracture was 745,435. (Some cases were excluded for more than one reason.) Women accounted

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for 580,129 of these fractures (79 percent) whereas men accounted for only 165,306 (21 percent) (Table 1). The great majority of the cases were among Whites (93 percent), while Blacks and those of other or unknown racial background each accounted for 3 percent.

The incidence of hip fracture among the elderly for this time period was 6.63 fractures per 1,000 per year. Adjusting incidence rates for age, White women experienced the highest incidence rates at 8.07 per 1,000, followed by White men at 4.28/1,000, Black women at 3.06/1,000, and Black men at 2.38/1,000. Examining incidence rates by one year age groups (Figure 1) shows that rates for White women increased exponentially from 1.63/1,000 in 65 year-olds, to 35.4/1,000 in women aged 95 years. A similar exponential pattern of increase was observed for White males, with rates increasing from 0.9/1,000 for 65-year-olds to 26.0/1,000 for 96-year-olds. The age-associated increase in incidence persisted in Blacks, but was less than exponential in women and nearly linear in men.

Discussion

The risk of fracture of the hip increased with age well into the tenth decade of life for women and men, and Blacks and Whites alike. Incidence rates for White women between the ages of 85 and 95 were especially high, with more than 3 percent of this population suffering a fracture of the hip. White men, Black women, and Black men also suffered from high rates of injury, with rates reaching nearly 3, 2, and 1 percent of the nonagenarians, respectively.

The rates for White men and women calculated in this study resemble those reported from the Scandinavian countries,[9–11] except that rates in the oldest women appear to be higher in Sweden.[11] Estimates from Rochester, Minnesota appear to underestimate rates for both men and women over the age of 80 years,[5–7] but this may be due to small sample sizes. It is noteworthy that our results substantiate prior national estimates using data from the National Hospital Discharge Survey for all race and age groups,[2,4,12] despite the previously noted problems with similar data.[13]

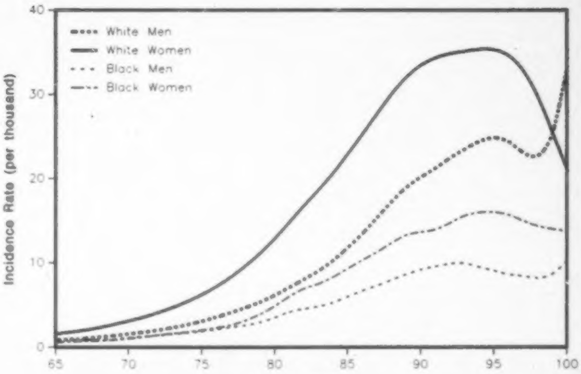

FIGURE 1—Annual Age-Specific Incidence of Hip Fracture among the Elderly: Population-based Rates by Race and Sex for 1984–87, United States
Lines represent a smoothed curve based on the calculated age-, race-, and sex-specific incidence rates.
SOURCES: Health Care Financing Administration, Department of Veterans Affairs, US Bureau of Census.

TABLE 1—Demographic Characteristics of Elderly Hip Fracture Patients Medicare and VA Population: 1984–87

	Sex		
	Women N (%)	Men N (%)	Total N (%)
All Races	580,129	165,306	745,435
Blacks	17,143	7,809	24,952
65–74	3,424 (20.0)*	2,697 (34.5)*	6,121 (24.5)†
75–84	6,819 (39.8)	3,063 (39.2)	9,882 (39.6)
85–94	5,966 (34.8)	1,820 (23.3)	7,786 (31.2)
95+	934 (5.4)	229 (2.9)	1,163 (4.7)
Whites	544,100	151,872	695,972
65–74	103,150 (19.0)	40,323 (26.6)	143,473 (20.6)
75–84	233,140 (42.8)	64,344 (42.4)	297,484 (42.7)
85–94	189,548 (34.8)	42,978 (28.3)	232,526 (33.4)
95+	18,262 (3.4)	4,227 (2.8)	22,489 (3.2)
Other	3,740	1,801	5,541
65–74	1,131 (30.2)	548 (30.4)	1,679 (30.3)
75–84	1,319 (35.3)	725 (40.3)	2,044 (36.9)
85–94	1,118 (29.9)	473 (26.3)	1,591 (28.7)
95+	172 (4.6)	55 (3.1)	227 (5.2)
Unknown	15,146	3,824	18,970
65–74	3,375 (22.3)	1,211 (31.7)	4,586 (24.2)
75–84	6,272 (41.4)	1,766 (46.2)	8,038 (42.4)
85–94	4,560 (30.1)	736 (19.3)	5,296 (27.9)
95+	939 (6.2)	111 (2.9)	1,050 (5.5)

*Percent of Race- and Sex-Specific Category.
†Percent of Race-Specific Category.

There are several limitations in these data. The assumption that all fractures of the hip necessarily result in hospitalization is probably valid, because hip fractures are associated with a great deal of pain and incapacity; but persons who did not survive long enough to be hospitalized would be missed. A second assumption is that persons hospitalized in this age range are covered by the Medicare insurance program or cared for in VA hospitals. According to the Health Care Financing Administration,[14] 97 percent of the United States population ages 65 and older is enrolled in the Medicare program. The number of cases treated in VA hospitals appears to account for the vast majority of the remaining 3 percent, suggesting these rates reflect true population rates.

These data may over-estimate the risk of an incident first fracture since data are only available for up to four years of follow-up. The rates presented herein may represent up to a 6 percent over-estimate of the risk of a first fracture. Likewise, the use of these data to estimate the prevalence of fracture would result in an underestimate for the same reason.

The apparent decline in fracture incidence after age 95 among white women is intriguing. Possibly, women who are at risk of fracture have been removed from the population through fracture-related mortality or competing causes. It is noteworthy that this decline persists when all fractures during the four years of follow-up are included in the numerator. Alternatively, this result may reflect some degree of nonsampling error inherent to the data. Only more detailed surveillance of an elderly population will provide the opportunity to ascertain the meaning of the decline.

ACKNOWLEDGMENTS

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Swaddling and Acute Respiratory Infections

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Abstract: In Turkey and China the ancient practice of swaddling is still commonly practiced. Both countries have extremely high rates of pneumonia, especially during the neonatal period. Preliminary evidence on the possibility that swaddling may interfere with normal respiratory function and thereby predispose to pneumonia was gathered in a teaching health center in Ankara. Babies who had been swaddled for at least three months were four times more likely to have developed pneumonia (confirmed radiologically) and upper respiratory infections than babies who were unswaddled. These preliminary findings were highly significant and are being followed up by further studies. (*Am J Public Health* 1990; 80:873–875.)

Introduction

The ancient practice of swaddling has almost disappeared in most countries of the world. A national sample survey in Turkey, however, showed that 93 percent of mothers swaddle their children.[1] In China also, most babies are tightly swaddled from birth through the first several months of life.[2] Since these two countries include over one-fifth of the children of the world, the number of swaddled babies is substantial.

In both countries pneumonia is the first cause of death among children, with particularly high incidence among neonates. In Turkey about 50,000 infant deaths occur annually due to pneumonia.[3] In China over 300,000 child deaths per year are attributed to pneumonia with a child mortality rate twice as high as the second highest cause of death.[4] Forty percent of these deaths are under one month of age.

In trying to explain this extremely high incidence of pneumonia we focused on the possibility that swaddling might interfere with normal respiratory function and lung expansion. No studies have been published of possible relationships between swaddling and acute respiratory infections or pneumonia.

The common cultural practice is that immediately after birth babies are tightly bound in layers of cloth. Complete swaddling immobilizes the baby from the neck to the feet. The legs are pressed firmly together with the knees straight and the arms are bound to the sides or slightly to the front of the body. The layers of cloth are not only pulled tightly but they are also securely tied to minimize body movement. In partial swaddling cloth is wrapped around the legs and torso up to the armpits, but the arms are free. In both types of swaddling the child may also be covered with netting or a blanket to prevent exposure to flies, drafts or cold air. Babies are almost always laid on their backs and kept in a dark room to induce sleep.[5] Swaddled babies seldom cry and respirations seem shallow to an observer, raising the question of whether full expansion of the lungs occurs. A variety of devices are used to dispose of excreta in Turkey but in the urban area where this study was done families use cloth diapers.

Methods

The records from Gulveren Health Center in a suburb of Ankara were examined to look for associations between swaddling and selected health problems. This teaching health center of Hacettepe Medical School has high standards of follow-up and care of all the children in the health center area. Records were available on 186 infants, of whom 94 had been unswaddled, 29 had been partially swaddled, and 63 had been completely swaddled. The rate of swaddling is lower than the national figure because this study included only those babies who were swaddled for at least three months.

All infants were examined and detailed histories were taken. The ages of the children at the time of this cross-sectional study ranged from three to 12 months, with a mean of 6.8 months. Sex ratios were similar in all groups as shown

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in Table 1. The mothers ranged in age between 21 and 25 years and literacy levels in the three groups were 84, 88, and 89 percent. The average number of people in each household was 5.0 in the unswaddled group, 4.81 in partially swaddled, and 5.47 in the completely swaddled group. Families were all from the same socioeconomic levels with most fathers employed in industrial plants in Ankara and approximately 11 percent unemployed in each group.

Body weights and developmental stages were similar in all groups. The history included careful questioning about respiratory infections; having more than two infections during the period up to examination was classified as frequent upper respiratory infections. Physical examination included observation for signs of rickets and congenital dislocation of the hip.

All children had been followed at the health center by midwives with high compliance for regularly scheduled clinic and home visits. If illness occurred, babies were usually brought to the health center. At the time of regularly scheduled visits, parents were also asked about illnesses treated elsewhere. All of this information was filled in on follow-up records. If the baby had special tests at a hospital, the laboratory and x-ray records were obtained and transferred to the follow-up cards. History of respiratory infections was included in this analysis only if the diagnosis had been recorded on the baby's follow-up records. A diagnosis of pneumonia was made only when clinical records showed cough, fever, and crepitations. All pneumonia cases had positive x-rays at the time of illness which were reviewed again as part of this study. Some had respiratory distress but none required hospitalization.

Results

Table 1 shows the frequency of respiratory illnesses identified in these infants. Pneumonia and a history of at least two upper respiratory infections were each about four times more common in swaddled than unswaddled babies. The association with partial swaddling was as strong as with complete swaddling and these groups were combined for statistical testing.

Discussion

Few studies have been done of the effects of swaddling. Lipton,[6] *et al*, reported that swaddling reduces motor activity and encourages the baby to sleep. Chisholm[7] confirmed these findings about motor activity and sleep and also reported less response to stimulation and less variation in heart rate. A report from Beijing[8] compared transcutaneous oxygen tension in 40 neonates with moderate pneumonia, confirmed radiologically, who were observed for periods when they were swaddled and unswaddled and placed in prone and supine positions. Measurements were made 30 minutes after feeding when the infant was asleep. Unswaddled babies in the prone position had oxygen tension 18 percent higher than swaddled supine babies and 12 percent higher than unswaddled supine babies. Several studies have shown that babies in the prone position have improved respiratory function when compared with babies in the supine position.[9,10] It may be that a combination of swaddling and the supine position produces the greatest effect on respiratory ventilation.

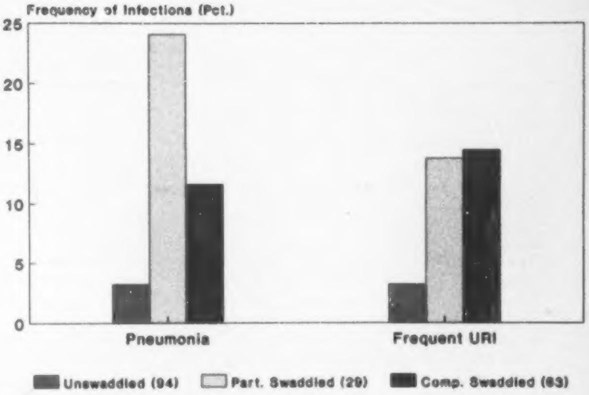

FIGURE 1—Swaddling and Respiratory Infections.

TABLE 1—Swaddling, Pneumonia and Respiratory Infections in Turkey

	Unswaddled (n:94)		Partially Swaddled (n:29)		Completely Swaddled (n:63)	
Age (months)	7.9 ± 2.3		8.1 ± 3.3		7.4 ± 2.1	
Male/Female	1.08		1.07		1.11	
Number in Household	5.0		4.81		5.47	
% Literacy of Mothers	84		88		89	
	n	%	*n*	%	*n*	%
Pneumonia*	3	3.2	7	24.1	8	11.6
Frequent URI*	3	3.2	4	13.8	10	14.5

*Fisher's exact test used to compare unswaddled with both groups of swaddled babies added together: for pneumonia p = .002 and for frequent upper respiratory infections p = .004.

Rickets was more common in swaddled babies than in unswaddled babies presumably because of lack of exposure to sunlight. In Israel, Block reported an association between swaddling and congenital dislocation of the hip[11] and similar results were reported among Navajo babies bound to cradle boards.[12] No such association was found in this series of cases.

The extremely high mortality and morbidity from neonatal and infant pneumonia in China and Turkey is being further investigated by prospective studies which will provide more precise information on time relationships between swaddling and pneumonia. If a causal relationship can be defined, educational efforts can try to modify this traditional practice. The possible advantages of swaddling should also be studied since parents say that a swaddled baby child is easy to care for because it is quiet and sleeping most of the time.

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Assessment of AIDS Knowledge, Attitudes, Behaviors, and Risk Level of Northwestern American Indians

ROBERTA L. HALL, PHD, DONI WILDER, BS, PAMELA BODENROEDER, BA, AND MICHAEL HESS, DDS

Abstract: A survey was made of 710 American Indians of Oregon, Washington, and Idaho to assess the population's knowledge, attitudes, and behaviors in respect to acquired immunodeficiency syndrome (AIDS), to estimate the population's risk, and to plan strategies to reduce it. In contrast to 3 percent of the general population, this study found 10.6 percent of male and 6.4 percent of female Pacific Northwestern American Indians in groups considered at high risk for AIDS. (*Am J Public Health* 1990; 80:875–877.)

Introduction

Assessment of the degree to which any population is at risk for infection with the human immunodeficiency virus (HIV) is difficult. The American Indian/Alaskan Native population presents a special challenge because of its heterogenous cultural roots and its dispersion within the general population. Few Native Americans who live on reservations have been included in the National Health Interview Survey (NHIS), which studies the public's knowledge and attitudes toward acquired immunodeficiency syndrome (AIDS) (Deborah Dawson, National Center for Health Statistics, personal communication, July 14, 1989).

No census exists of persons with Native American ancestry; many in rural or reservation areas do not have telephones, and are not represented in telephone surveys. Unpublished AIDS knowledge, attitudes and behavior studies include data from women clients in a WIC (Women, Infants and Children) program; a survey of health care workers in Arizona; a survey of junior college students who primarily have Indian ancestry; and a survey of health service workers who work primarily with American Indians in the San Diego, California area (Steven Helgerson, Indian Health Service, personal communication, November 7, 1989).

Current literature reports a low rate of known AIDS cases in the American Indian population, especially in comparison to other minority groups,[1–3] but data on HIV infection do not exist and current information could understate risk in this relatively small and vulnerable population. In order to assess risk and recommend appropriate educational and preventive initiatives, the Northwest Portland Area Indian Health Board conducted an extensive survey of AIDS knowledge, attitudes, and behaviors among American Indians who live in the Pacific Northwest states of Oregon, Washington, and Idaho.

Methods

The questionnaire* was adapted from an Indian Health Service form, which included many of the items on the NHIS.[4] Questions probed respondents' knowledge about AIDS, attitudes toward people with AIDS, and behaviors related to HIV transmission. The questionnaire included a number of questions on sexual behavior (number and sex of partners, degree of acquaintance with partners, age at first sexual intercourse, etc.) and on the use of various licit and illicit drugs, including alcohol. Demographic questions asked respondents to identify their age, sex, ethnic affiliation, and education, and to categorize their residence by on or off reservation, community type and size, and state and county.

The survey was administered from September 1988 through March 1989 at 24 Indian centers in Oregon, Idaho, and Washington either by a member of the staff of the Northwest Portland Area Indian Health Board or by staff at the participating agency. Sixty-six percent of respondents were surveyed at health clinics or health stations, 17 percent at tribal offices, and 17 percent at Indian educational or community agencies. Respondents include employees, persons conducting tribal business, persons seeking health care, and family members accompanying them. All respondents were asked to complete the questionnaire; anonymity was guaranteed and individuals were assured that they would not be denied any tribal service if they chose not to answer the survey, or any part of the survey.

The sample consisted of 710 persons from ages 12 to 78 with a median age of 33 years; 237, 283, and 190 respondents were from Oregon, Washington and Idaho, respectively. Women represented 73 percent of the sample (Table 1). Idaho had the largest percentage resident on a reservation (85 percent), Washington was intermediate (69 percent), and Oregon was lowest (43 percent). This percentage did not differ by sex, but fewer of the age group under age 30 resided on reservations (59 percent) than in the age group over 50 (71 percent), while the age group from 30 to 49 was intermediate (65 percent).

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*For a copy of the questionnaire or a tabulation of responses, please write to the NW Portland Area Indian Health board, 520 SW Harrison, Suite 440, Portland, OR 97201.

TABLE 1—Sample Distribution by Age, Sex, and Risk Group*

	Age Groups (years)			
	12–17	18–29	30–49	50–78
Sex	N (%)	N (%)	N (%)	N (%)
Male	21 (41.2)	49 (23.9)	73 (24.7)	33 (31.1)
Female	30 (58.8)	156 (76.1)	222 (75.3)	73 (68.9)
Total	51 (7.8)	205 (31.2)	295 (44.9)	106 (16.1)
Risk Groups	8 (22.9)	93 (48.7)	187 (66.1)	93 (90.3)
Middle	25 (71.4)	78 (40.8)	74 (26.1)	8 (7.8)
High	2 (5.7)	20 (10.5)	22 (7.8)	2 (1.9)
Total	35 (5.7)	191 (31.2)	283 (46.2)	103 (16.8)

*Fifty-three persons (7%) did not provide their age; of these, 17 also did not provide information on sexual behaviors; an additional 45 (9% altogether) indicated their age but not their sexual behavior. Percentages are based on those responding to specific questions.

Since there was no selection among persons who visit Indian agencies to use tribal services, the sample is believed to represent that population well; those who do not use these services, such as homeless individuals and those on Skid Road, may be underrepresented. The relatively large number of women in the sample is probably due to their greater use of tribal services during business hours. To control for sex and age and to allow comparison among states and with sex and age groups surveyed in the NHIS, all responses were tabulated by sex, age, and state.[5]

Six males who had sexual relations with other males and 12 males and 30 females who have taken drugs intravenously were designated as members of the high-risk group, while middle-risk group members consisted of those who had two or more sexual partners in the past year or who had been involved with a person he/she did not know well. The low-risk group consisted of all others after exclusion of 62 persons who did not answer any of the questions about sexual behavior.

Results

Of the classifiable respondents, 7 percent were in the high-risk group, 30 percent were in the middle-risk group, and 63 percent were in the low-risk group (Table 1). Even if all 62 persons who did not answer sexual behavior/drug use questions were considered in the low-risk category, the proportion of high-risk respondents still would be considerably higher than that in other samples, i.e., 6.8 percent in this sample compared to 2 percent in the Hispanic population,[6] 4 percent in the Black population,[7] and 3 percent in the general population.[4]

The knowledge level of the sample does not differ markedly from that of the general population as reported by the NHIS for December 1988,[4] (Table 2). Other unpublished surveys in selected Indian populations have produced similar results in terms of knowledge (Steven Helgerson, personal communication, November 7, 1989). As has been found in other samples, respondents' knowledge is better about specific clinical properties of the disease than knowledge concerning transmission.[1,8]

Discussion

The American Indian population of the Pacific Northwest is at potential risk for high rates of HIV infection not only because of the relatively large numbers in high-risk groups but because of the large numbers of youth in the middle-risk group and the small size of many of its 39 tribes. The middle-risk group is predominantly young and male (42.9 percent of males as opposed to 25.3 percent of females). Use of alcohol and illicit drugs is much higher among middle-risk

TABLE 2—Percentage of Correct Answers to Selected Knowledge Questions by NHIS and Northwest Indian Samples

	NHIS December 1988[4]		Northwest Indian Sample				
Questions	Male	Female	Male	Female	Low-Risk	Medium-Risk	High-Risk
1. AIDS is a disease caused by a virus[a]	85	79	83	78	78	80	77
2. Any person with the AIDS virus can pass it on to someone else during sexual intercourse.[a]	95	96	95	96	97	91	98
3. A pregnant woman who has AIDS can give AIDS to her baby.[a]	94	95	89	94	94	91	90
4. How likely do you think it is that a person will get AIDS or the AIDS virus from the following?							
A. Eating in a restaurant where the cook has AIDS.[b]	45	48	45	46	45	45	34
B. Working near someone with AIDS.[b]	67	66	68	65	66	62	60
C. Being coughed or sneezed on by someone with AIDS.[b]	42	43	43	37	40	35	34

[a] Definitely true or probably true were scored as correct.
[b] Very unlikely or definitely not possible were scored as correct.

group members than among those in the low-risk group.[5] Middle-risk group members reported their first sexual experience at a younger age than those in either the high- or low-risk group, and women in the middle- and high-risk group who have had pregnancies were younger at the time of their first pregnancy than those in the low-risk group.[5] Finally, over half of the middle-risk group, compared to 13 percent of low-risk and 41 percent of high-risk groups, reported having sexual partners from both reservation and non-reservation communities. If introduced into one of the small reservation communities, HIV could decimate the population.

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Steady Increase Reported in Health Personnel; Shortages Persist among Nurses, Minorities

Despite recent declines in the numbers of health professions school graduates, the United States supply of active health personnel has risen steadily since 1970, and ratios of health personnel to population are currently at their highest levels, according to a recent report from the Health Resources and Services Administration (HRSA). In submitting the report to the Congress, Health and Human Services Secretary Louis W. Sullivan warned that, "While the numbers generally show that we have a strong foundation to meet personnel requirements through the end of the century, they also reveal problems that will continue to demand our attention." Highlights of the report include the following:

- Black and Hispanic physicians constitute only 3 percent each of the total physician supply, while Blacks account for 12 percent of the total US population and Hispanics for 7 percent. First-year and total enrollments of minorities in health professions schools have not changed significantly in recent years, and Black enrollment has shown less increase than other minority groups.
- The smaller graduating classes and continuing exits from the health work force are expected to impact on the field between the years 2000 and 2020. Growth in the supply of many health professions, such as nursing and dentistry, is expected to slow.
- A national shortage of registered nurses exists despite growth in the supply from 750,000 in 1970 to more than 1.6 million in 1988. Although the active supply will continue to increase over the next 15 years, the present shortage evokes concern about projections of a smaller supply of nurses in the future.
- More primary care practitioners are needed to provide services for patients in their initial contact with the health care system, and to address rural and inner-city health problems as well as promote health enhancement and illness prevention.
- Recent studies and surveys also reveal shortages of personnel in public health, allied health, geriatrics and gerontology, the report noted.

More information on the report, *Seventh Report to the President and Congress of Health Personnel in the United States,* is available from the Office of Data Analysis and Management, Bureau of Health Professions, Room 8-47, HRSA, 5600 Fishers Lane, Rockville, MD 20857. Tel: 301/443-6936.

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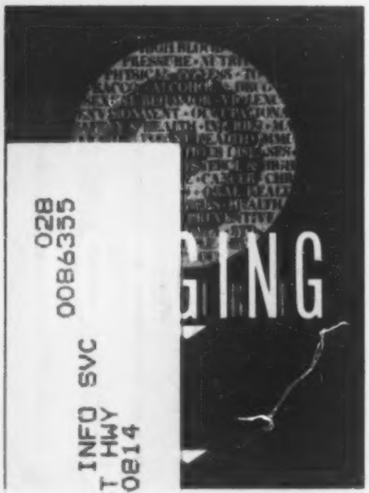

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Commentary

The Federal Environmental Health Workforce in the United States

Ken Sexton, ScD, and Susan A. Perlin, ScD

Abstract: This paper summarizes existing data on the size and composition of the federal environmental health workforce, delineates the major categories of activities carried out by its members, identifies current and emerging issues that are likely to affect workforce activities, and makes qualitative inferences about future trends and directions. Findings suggest that there is a current and future need for more and better qualified professionals in the federal environmental health workforce. (*Am J Public Health* 1990; 80:913–920.)

Introduction

The United States federal government has responsibility for protecting the public from the adverse consequences of exposure to potentially harmful environmental agents. The importance of the nation's environmental health has been recognized during the past 20 years, as evidenced by the passage of more than a dozen major environmental laws and subsequent amendments, including the: Clear Air Act; Safe Drinking Water Act; Toxic Substances Control Act; Federal Insecticide, Fungicide, and Rodenticide Act; Resource Conservation and Recovery Act; and Comprehensive Environmental Response and Compensation Act ("Superfund").

The federal government is the single largest employer of environmental health professionals in the United States. Although the Environmental Protection Agency (EPA) has the lead role in administering and enforcing many environmental laws, other federal agencies, such as the Public Health Service (PHS) and the Occupational Safety and Health Administration (OSHA), also have direct statutory authority or involvement in environmental health issues. Moreover, many environmental health professionals are employed by federal agencies whose primary mission is not related directly to the protection of environmental health (e.g., the Department of Defense). Major Executive Branch agencies with environmental responsibilities are shown in Figure 1.

Attempts to evaluate the environmental health workforce, federal and otherwise, are a relatively recent development.[1–6] Owing to a variety of factors, there is little consensus about its size and composition. Among the problems are the absence of a generally accepted definition for environmental health, disagreement about the discrete specialties that comprise the workforce, the diversity of job titles within the field, the wide variety of responsibilities and programs in environmental health, differing employers, and the varied professional/technical/administrative skills required in different environmental health settings.[1–2]

Our objective is to examine the federal environmental health workforce by using available information and to draw qualitative inferences about current and future directions. It is important to note that we specifically exclude members of the Armed Services from our analysis. Although there are certainly a substantial number of environmental health professionals contained therein, obtaining objective data on their number and function is problematic.

The Existing Skills Mix

The federal environmental health workforce is defined broadly to include all civilian members of the federal government and the Commissioned Corps of the Public Health Service, whose primary duties and responsibilities are the identification, assessment, management, communication, or remediation of human health risks that result from environmental factors. This definition encompasses a diverse group of professionals, trained in a multitude of academic disciplines, and focusing on a wide variety of issues. Among the myriad of problems addressed by the environmental health workforce are air quality, water quality, food protection, vector control, waste management and control, consumer protection, noise control, and general environmental health issues, including direct and indirect effects on human health from ecological changes.

Within the federal government, all civilian employees who are not members of the Senior Executive Service (SES) are assigned to a particular civil service job classification series. Many of the job classifications are broadly defined. Thus, a person classified as a Public Health Program Specialist in one agency may have vastly different training, educational background, work experience, and duties and responsibilities than a person with the same classification in another agency, or even in another division within the same agency. The Environmental Protection Specialist classification, for example, which is used to the greatest extent by EPA, is defined so broadly that almost any environmental health professional, and some non-health related professionals, can be so classified.

Toxicology and epidemiology are two academic disciplines that are traditionally considered to be an integral part of the environmental health workforce. Yet until recently, neither specialty was classified as a separate job category within the federal government. Although EPA and other agencies are beginning to reclassify toxicologists into the newly created toxicology series, many are still categorized as Medical Officers, Chemists, Mathematical Statisticians, Environmental Engineers, or General Biological Scientists. Epidemiologists still do not have a separate job title and are classified in a wide variety of series, which vary by agency.

Address reprint requests to Ken Sexton, ScD, Director, Office of Health Research (RD-683) US Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460. Dr. Perlin is a staff scientist in the same office. This paper, submitted to the Journal February 28, 1989, was revised and accepted for publication February 22, 1990.

Editor's Note: See also related editorial p 904 this issue.

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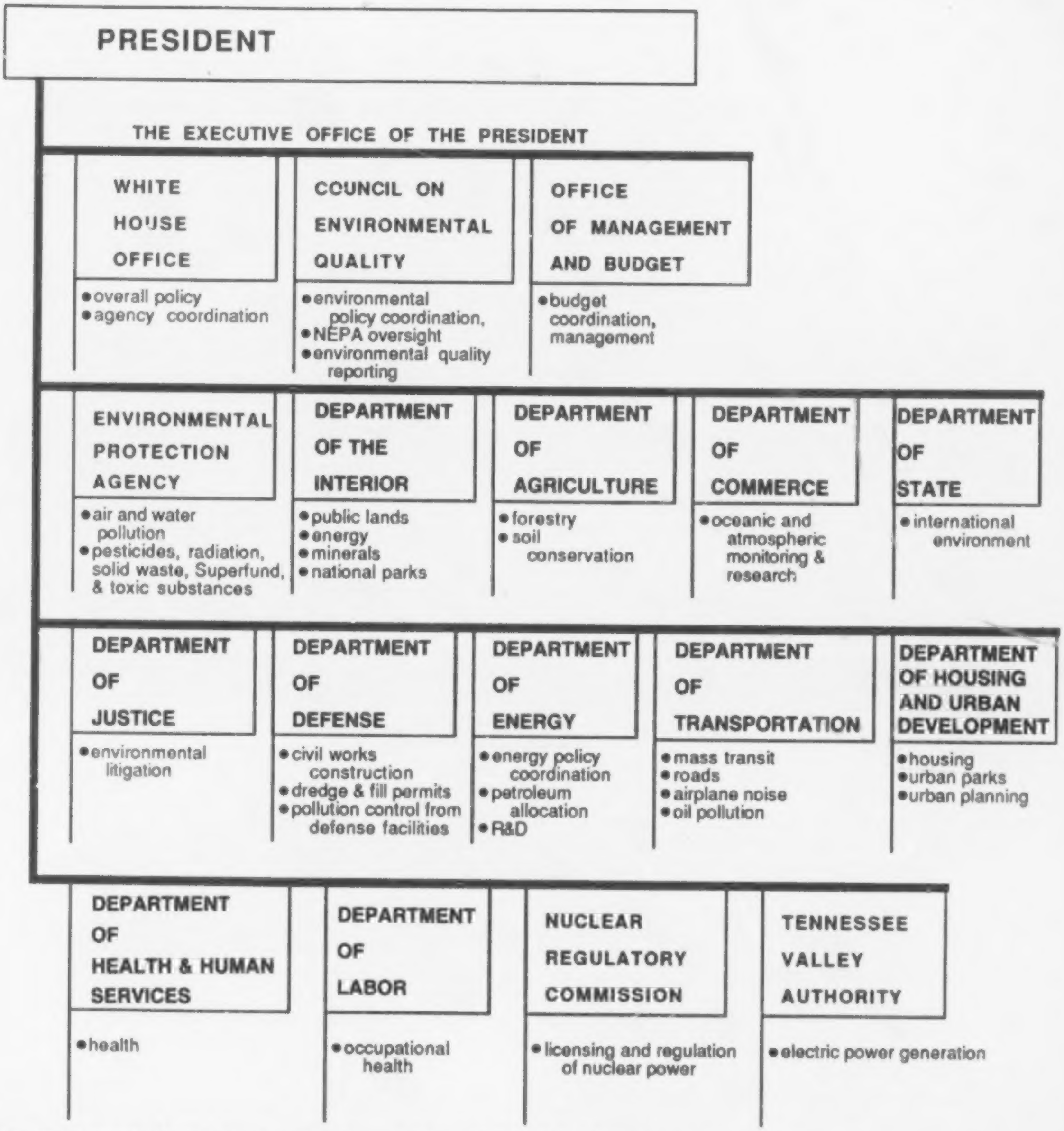
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TENNESSEE VALLEY AUTHORITY
•electric power generation

FIGURE 1—Major Executive Branch Agencies with Environmental Responsibilities, United States (adapted from ref. 16).

Keeping these caveats in mind, we used the Civil Service job classifications to examine the current federal environmental health workforce. Data given in Table 1 provide a summary for eight executive branch agencies of the number of civilian employees who are listed in job classifications that we believe are most directly related to environmental health. An indication of their collective contribution to the total number of employees in the selected job categories from across the entire federal government can be inferred from percentage figures in the last column of the table.

These data suggest that there are a substantial number of environmental health jobs in federal agencies whose primary mission is not protection of public health (e.g., Department of Agriculture, Department of Defense), and that, of the 27 job categories listed, most employees (75 percent) fall into one of eight job classifications: Medical Officer, Biological Technician, General Biological Science, Safety Management, Veterinary Medical Science, Environmental Engineer, Microbiology, and Environmental Protection Specialist.

In the entire federal government, the total number of full-time, white collar, civilian workers (excluding the Postal Service) was 1,602,438 as of October 1985. In the same year, the total for EPA, OSHA, and the PHS (three agencies directly involved with environmental health issues) was 60,298. The total number of employees in the 27 environmental health-related job classifications was 28,919 for the

TABLE 1—Workforce Statistics for Environmental Health-Related Job Classifications in Eight US Federal Agencies

Civil Service Job Classification	Number of Employees[a]								
	EPA	Defense[b]	HHS[c]	USDA	Interior	Energy	Labor	State	Total[d](%)[e]
Safety Management	12	1975	41	41	113	53	840	4	3079 (87)
Safety Technician	2	123	6	10	14	1	0	0	156 (76)
Environmental Protection Specialist	1162	161	0	12	183	75	0	0	1593 (88)
Environmental Protection Assistant	171	29	0	0	5	0	0	0	205 (97)
General Biological Science	574	799	879	607	1328	27	0	2	4216 (89)
Microbiology	79	290	885	313	20	1	0	0	1588 (86)
Biological Technician	56	545	700	2231	742	3	0	0	4277 (74)
Pharmacology	44	57	280	12	1	0	0	0	394 (90)
Physiology	10	128	95	72	16	0	0	0	321 (71)
Toxicology[f]	0	0	0	0	0	0	0	0	0[f] —
Genetics	6	2	51	208	2	1	0	0	270 (96)
Biological Science Student Trainee	5	28	10	300	44	0	0	0	387 (97)
General Health Science	58	61	721	0	0	2	15	0	857 (50)
Medical Officer	6	761	1542[g]	2	1	2	9	58	2381 (25)
Public Health Program Specialist	0	0	1060	0	0	0	0	0	1060 (90)
Sanitarian	0	10	36	0	3	0	0	0	49 (98)
Industrial Hygiene	8	390	47	3	6	14	473	0	941 (93)
Consumer Safety	32	0	1483	0	0	0	0	0	1515 (100)
Environmental Health Technician	0	92	46	4	2	0	0	0	144 (96)
Veterinary Medical Science	5	14	93	1948	7	0	0	0	2067 (99)
Safety Engineering	1	358	8	0	17	24	85	0	493 (80)
Environmental Engineering	1614	694	16	20	30	29	0	0	2403 (97)
Biomedical Engineering	1	30	40	2	1	0	0	0	74 (30)
Health Physics	22	188	22	3	2	50	0	0	287 (50)
Public Health Educator	0	2	29	0	0	0	0	0	31 (91)
Consumer Safety Inspection	2	0	101	0	0	0	0	0	103 (99)
Public Health Quarantine Inspection	0	0	28	0	0	0	0	0	28 (100)
Total for Job Classifications Listed	3870	6737	8219	5766	2537	282	1422	64	28,919 (70)
Total Workforce[h]	11,822	650,517	115,872	98,282	56,135	14,392	17,504	14,936	979,460 (61)

a) All data are current as of 10/31/85 and were provided by the Federal Office of Personnel Management. All figures are based on full-time, white collar, federal civilian workers, excluding the Postal Service.

b) Defense includes only civilian employees of army, navy, air force.

c) Health and Human Services (HHS) has several offices and administrations, including the: Public Health Service (See footnote b, Table 2), Social Security Administration, Office of Human Development Services, US Office of Consumer Affairs, Health Care Financing Administration, and the Family Support Administration.

d) Total employees in each job classification for the eight agencies listed. Figures do not include Commissioned Corps of the Public Health Service.

e) Percentage of the entire federal government workforce for the specific job category, based on full-time, white collar civilian employees, excluding the Postal Service. For example, the 3,079 employees in the eight agencies who are classified in safety management represent 87% of the people in that job series across the whole federal government.

f) Toxicology is a new job series and there were no employees listed in this category as of 10/31/85. The process of reclassifying toxicologists is currently underway in several agencies.

g) The majority of these medical officers are in the Public Health Service, with approximately half directly involved in patient care and half involved in medical research.

h) Total workforce includes all full-time, white collar federal civilian workers for each listed Agency. This includes the workforce for the 27 job classifications listed, plus all other full-time employees, regardless of whether or not they are involved in environmental health-related jobs. This includes all support staff, such as secretaries, budget and personnel staff, and all managers.

eight selected agencies, that is 70 percent of all employees so classified in the federal government as a whole (Table 1).

In Table 1 we did not include more generic classifications, such as chemist, physical scientist, or statistician, because we were less certain that individuals in these categories would be involved in environmental health activities for all of the agencies listed. Nevertheless, individuals so classified and who work in a federal agency that deals primarily with environmental health issues are an important part of the environmental health workforce. Information for 1988 on the number and types of environmental health practitioners (including chemists, physical scientists and statisticians) in eight of the federal agencies most directly responsible for environmental health issues is given in Table 2. For EPA, the addition of six of these generic job categories increased the identified workforce by about 20 percent.

Because of EPA's lead role in many environmental health issues and owing to the relatively large number of environmental health professionals employed therein, Table 3 provides a more detailed description of EPA's environmental health workforce. Considering full-time, part-time, and intermittent employees, about 16 percent are involved directly with research and development; 27 percent are in regulatory offices in Washington, DC where they have responsibility for developing and carrying out environmental laws and regulations; 50 percent are employed in the 10 EPA regional offices where they oversee implementation and enforcement of regulations; and 6 percent provide necessary technical and administrative support.

Current Federal Environmental Health Activities

We categorized all environmental health activities into one or more of four general categories: research and development; risk assessment (including hazard identification); risk management/reduction; and risk communication. A description of these four categories with examples of related activities is provided in Table 4.

Many of the environmental health activities in the federal government are focused on risk assessment and risk management. To aid decision-making, agencies such as EPA, OSHA, and the Food and Drug Administration have developed formal risk assessment procedures for identifying health

TABLE 2—Workforce Statistics for Environmental Health-Related Job Classifications in Selected US Federal Agencies that are Primarily Responsible for Environmental Health Issues

	Number of Employees[a]							
			Public Health Service[b]					
Civil Service Job Classification	EPA[c]	OSHA[d]	FDA[e]	Commissioned Corps[f]	CDC[g]	NIEHS[h]	NIOSH[i]	ATSDR[j]
Job classifications likely to be involved with environmental health activities regardless of agency mission								
Safety Management	8	830	4	3	11	1	5	0
Safety Technician	1	1	3	0	0	0	0	0
Environmental Protection Specialist	1456	0	0	0	0	0	0	0
Environmental protection Assistant	200	0	0	0	0	0	0	0
General Biological Science	570	0	239	18	141	139	10	4
Microbiology	91	0	383	44	244	11	2	0
Biological Technician	45	0	133	0	93	136	8	0
Pharmacology	25	0	154	11	8	13	8	0
Physiology	10	0	26	8	8	9	7	0
Toxicology	72	0	0	0	1	8	0	1
Genetics	6	0	3	0	4	22	1	0
Biological Science Student Trainee	2	0	4	0	1	0	0	0
General Health Science	87	13	47	67	66	17	22	12
Medical Officer	8	2	575	1651	29	11	4	2
Public Health Program Specialist	0	0	20	107	578	0	2	19
Sanitarian	1	0	26	156	0	0	0	0
Industrial Hygiene	15	502	2	86	16	6	27	0
Consumer Safety	18	0	1486	59	0	0	0	0
Environmental Health Technician	0	0	0	0	1	0	1	0
Veterinary Medical Science	6	0	86	87	1	16	0	0
Safety Engineering	1	83	2	1	4	0	4	0
Sanitary Engineering	1918	0	20	367	10	0	0	8
Biomedical Engineering	1	0	52	10	0	1	0	0
Health Physics	40	0	48	63	2	4	0	0
Public Health Educator	1	0	0	19	5	0	1	0
Consumer Safety Inspection	0	0	133	0	0	0	0	0
Public Health Quarantine Inspection	0	0	0	0	31	0	0	0
Job classifications likely to be involved with environmental health activities in agencies responsible for environmental health issues								
Physical Science Technician	69	3	93	0	14	5	14	0
Chemist	638	57	1042	39	151	94	55	0
Operations Research	32	0	17	0	0	0	0	0
Mathematical Statistician	25	0	83	12	63	8	3	1
Statistician	43	4	31	56	203	3	16	0
Statistical Assistant	3	1	12	0	77	0	12	0
Total for Listed Job Classifications	5396	1496	4724	2864	1762	504	202	47
Total Workforce[k]	13,601	2360	6721	5600	4600	556	800	150

a) With the exception of the Public Health Service (PHS), all figures are based on white collar civil service employees, excluding the Commissioned Corps.

b) The *Public Health Service* is an operating division within HHS and includes the following agencies: ATSDR, FDA; NIH (including NIEHS); Alcohol, Drug Abuse and Mental Health Administration; Health Resources and Service Administration; Indian Health Service; Office of the Assistant Secretary of Health; and CDC, which includes the National Institute for Occupational Safety and Health (NIOSH), Center for Environmental Health and Injury Control, Center for Infectious Diseases, Center for Prevention Services, National Center for Health Statistics, Center for Health Promotion and Education, Training and Laboratory Program Office, International Health Program Office, Epidemiology Program Office, and the Office of Program Support.

c) EPA (Environmental Protection Agency), data current as of 12/1/88, provided by the EPA Office of Administration and Resources Management, and represent permanent, full-time, civil service.

d) OSHA (Occupational Safety and Health Administration), data were provided by the OSHA Office of Personnel and are current as of 7/30/89.

e) FDA (Food and Drug Administration), data current as of 4/1/88, provided by the Department of Health and Human Services, Office of the Assistant Secretary for Health.

f) Commissioned Corps of the Public Health Service, irrespective of agency, data current as of 4/1/88 and provided by the Division of Commissioned Personnel.

g) CDC (Centers for Disease Control), data current as of 5/31/88, provided by Personnel Management Office of CDC.

h) NIEHS (National Institute of Environmental Health Sciences), data current as of 5/21/88, provided by personnel office, NIEHS, Research Triangle Park, NC.

i) NIOSH (National Institute for Occupational Safety and Health), data are current as of June 1988, and were provided by the Personnel Management Office of the Centers for Disease Control.

j) ATSDR (Agency for Toxic Substances and Disease Registry), data are current as of June 1988, and were provided by the Personnel Management Office of the Centers for Disease Control.

k) Total workforce refers to all full-time, white collar federal civilian workers for each listed agency, including those people in the 23 job classifications listed, and all other full-time employees including all support staff such as secretaries, budget and personnel staff, and all managers. The only exceptions is PHS, which includes only the Commissioned Corps, and has only degreed scientists, engineers, doctors, etc.

hazards and for estimating the risks to human health posed by products and activities.[7-9] Risk management procedures are employed for weighing policy alternatives and for selecting the most appropriate action by integrating the results of risk assessment with engineering data and with social, economic, and political concerns.[10] The interrelationships among research and development, risk assessment, risk management, risk reduction, and risk communication are depicted schematically in Figure 2.

As shown in Table 3, most of the EPA workforce is involved in the application of scientific data to the resolution of environmental health problems (e.g., risk management and risk reduction).[11] A relatively smaller number is involved directly with data generation (research and development), while a steadily increasing fraction of the workforce is involved in risk assessment and risk communication, a trend that is expected to continue into the foreseeable future.[12-14]

Emerging Environmental Health Issues

Advances in the field of environmental health sciences, introduction of innovative technologies, and promulgation of new environmental regulations are examples of the kinds of activities that can have significant impacts on the future size, composition, and activities of the environmental health workforce. For example, increasing awareness of the potential health hazards associated with municipal and hazardous wastes led to passage of the Resource Conservation and Recovery Act which, in turn, created an expanded need for environmental health practitioners in all aspects of waste management, including collection, transport, storage, treatment, and disposal, as well as stimulating research and development on related health and risk reduction issues.

Attempts have been made to examine the environmental health issues that are likely to be most significant over the next decade or more.[15-25] Some of the more important issues are discussed briefly below.

Detection of Health Effects

Just as environmental monitoring has progressed so that it is now possible to measure pollutant concentrations at the part-per-trillion level, so too must our capabilities to ascertain target tissue concentrations, and to detect effects at the cellular and molecular level be enhanced. Coupled with similar improvements in our understanding of the basic biological mechanisms that underlie health effects, this will allow for greater certainty and accuracy in assessment of environmental health risks.

Molecular epidemiology, the use of biologic indicators to link individual exposure with health outcome, is gradually becoming a reality. Use of these techniques within the context of epidemiologic investigations offers a means to assess health risks more directly and thereby reduce uncertainties.[26,27]

Non-Cancer Health Effects

Current and future research efforts are likely to focus on several non-cancer effects of environmental agents (e.g., pulmonary, cardiovascular, reproductive, developmental, neurologic, immunologic, hepatic, and dermal) to determine which health outcomes are important and in what kinds of situations.[28]

High-Risk Groups

Advances in our understanding of biological predisposition to a particular health effect (e.g., by virtue of age or genetic susceptibility),[29] as well as in our knowledge of human activities and lifestyles that give rise to elevated exposures (e.g., time spent inside a building with air pollution problems)[30,31] will continue to help focus research and regulatory efforts on the appropriate population subgroups. More precise techniques to identify and study populations

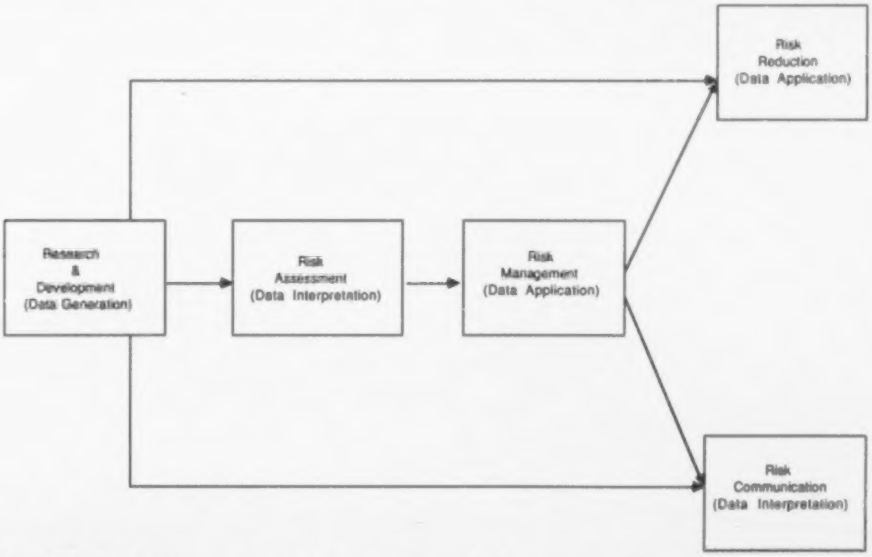

FIGURE 2—Relationships among Research and Development, Risk Assessment, Risk Management, Risk Communication, and Risk Reduction

TABLE 3—The Environmental Health Workforce Arranged According to Functional Categories within the US Environmental Protection Agency

	Number of Employees in Four Major EPA Functional Categories[a]							
	Research	Regulatory Offices						
Civil Service Job Classification	Office of Research & Development[b]	OPTS[c]	OSWER[d]	OW[e]	OAR[f]	Regions[g]	Other[h]	Total
Job classifications likely to be involved with environmental health activities regardless of agency mission								
Safety Management	0	0	1	0	0	7	0	8
Safety Technician	0	0	0	0	1	1	0	2
Environmental Protection Specialist	22	199	192	117	94	846	79	1549
Environmental Protection Assistant	17	10	1	1	4	183	4	220
General Biological Science	220	170	10	32	5	182	92	711
Microbiology	60	28	0	2	0	11	2	103
Biological Technician	111	3	0	0	0	3	0	117
Pharmacology	10	19	0	1	0	1	5	36
Physiology	10	2	0	0	0	0	0	12
Toxicology	23	38	0	4	0	14	2	81
Genetics	4	2	0	0	0	0	0	6
Biological Science Student Trainee	0	0	0	0	0	2	0	2
General Health Science	49	13	8	1	8	10	19	108
Medical Officer	5	4	0	0	0	1	19	29
Public Health Program Specialist	0	0	0	0	0	0	0	0
Sanitarian	0	0	0	0	1	0	0	1
Industrial Hygiene	2	1	0	0	0	5	9	17
Consumer Safety	0	0	0	0	0	18	0	18
Environmental Health Technician	0	0	0	0	0	0	0	0
Veterinary Medical Science	5	1	0	0	1	0	3	10
Safety Engineering	0	0	0	0	1	0	0	1
Environmental Engineering	115	3	62	93	169	1513	41	2007
Biomedical Engineering	1	0	0	0	0	0	0	1
Health Physics	13	0	1	0	18	11	3	47
Public Health Educator	0	0	0	0	1	0	0	1
Consumer Safety Inspection	0	0	0	0	0	0	0	0
Public Health Quarantine Inspection	0	0	0	0	0	0	0	0
Job classifications likely to be involved with environmental health activities in agencies responsible for environmental health issues								
Physical Science Technician	75	8	0	4	12	22	10	141
Chemist	239	167	23	21	13	176	62	701
Operations Research	4	6	2	6	5	0	9	32
Mathematical Statistician	14	1	1	0	7	1	3	27
Statistician	12	17	0	4	4	1	17	55
Statistical Assistant	1	0	0	2	0	0	0	3
Total of Listed Job Classifications	1012	692	301	288	344	3008	379	6046
Total for Whole Office	1996	1240	750	677	917	7208	3011	15,799

a) Figures provided by EPA Office of Administration and Resources Management and are current as of December 1, 1988. Figures represent civil service permanent employees, including full-time, part-time, intermittent, and temporary employees. Full-time employees work 80 hour/2 weeks; part-time employees work less than 80 hour/2 weeks. Intermittent employees work no more than 130 days/year and are primarily advisory board members and consultants. Some consultants are also in the full-time, temporary category.

b) ORD, the Office of Research and Development, is the primary research arm of EPA.

c) OPTS, the Office of Pesticides and Toxic Substances, has primary responsibility for regulating pesticides (under FIFRA, the Federal Insecticide, Fungicide, and Rodenticide Act) and other toxic chemicals (under TSCA, the Toxic Substances Control Act).

d) OSWER, the Office of Solid Waste and Emergency Response, has primary responsibility for administering programs that address hazardous and solid wastes, including the Superfund program, underground storage tanks and active Resource Conservation and Recovery Act (RCRA) facilities.

e) OW, the Office of Water, has primary responsibility for regulating contaminants in drinking water, ground water, and surface water.

f) OAR, the Office of Air and Radiation, has primary responsibility for regulating air emissions under the Clean Air Act and for administering the agency's radiation program.

g) Regions, the 10 regional offices have the primary responsibility of carrying out the various regulations in different areas of the country.

h) Other, includes the Office of the Administrator, and the following offices: Enforcement and Compliance Monitoring, General Counsel, Inspector General, External Affairs, Administration and Resources Management, and Policy, Planning and Evaluation.

that are at higher risk because of either increased susceptibility or elevated exposures are needed.

Health Hazard Identification

Currently, there are several issues and/or technologies for which the hazard identification process is underway, including: human exposure to non-ionizing radiation (particularly Extremely Low Frequency radiation inside residences)[32,33]; non-asbestiform fibers used to replace asbestos in buildings[34]; methanol used as an alternative fuel in motor vehicles[35]; and the release of genetically engineered and naturally occurring microorganisms in conjunction with

TABLE 4—General Categories of Activities Carried out by the US Environmental Health Workforce

Activity Category	Description of Activities	Example Activities
Research and Development	Scientific research and development to generate appropriate data on relevant environmental health issues. The goal is to improve the quantity and quality of the existing data base, as well as to enhance our understanding of basic underlying mechanisms.	Animal toxicology Epidemiology Human clinical research Environmental monitoring
Risk Assessment	Assessment and evaluation of available environmental health data to determine their appropriateness and adequacy for incorporation into decisions about safeguarding public health. The goal is often to develop a quantitative health risk assessment in order to identify and prioritize environmental hazards.	Evaluation of data validity and completeness Hazard identification Risk characterization Development of guidelines (e.g., risk assessment, toxicity testing)
Risk Management and Risk Reduction	The use of environmental health data to make, implement, and enforce policy decisions about protection of public health. The goal is to improve decisions that affect environmental health, reduce public health risks, facilitate implementation of decisions, and enhance enforcement activities.	Policy and regulatory decisions Pollution prevention, control, and remediation Enforcement and compliance activities Promulgation of testing guidelines
Risk Communication	Communication of the risks associated with exposures to environmental agents, as well as the scientific basis for risk management decisions. The goal is to provide environmental health practitioners and the public with usable and understandable information about environmental health issues.	Technology and information transfer Explanation of scientific basis for decisions Implementation of "Public Right-to-Know" laws Communication of the health significance of environmental exposures

the burgeoning biotechnology industry.[36,37] Both research and regulatory decisions will be affected by the outcome of these and other hazard assessment activities.

Pollution Prevention

Historically, EPA has emphasized the use of pollution control equipment to reduce health and environmental risks (e.g., stack scrubbers for SO_x, tailpipe catalysts for automotive emissions). Informally known as "end-of-pipe" controls, these measures focus on reducing pollutant emissions after they have been generated. As we move into the 1990s, however, it is becoming increasingly apparent that many environmental health problems are not amenable to this approach. Indoor air pollution, global warming, and runoff from farms and construction sites are examples of problems that are not readily solved by these traditional approaches. Thus, it is imperative that EPA and other environmental health agencies develop strategies that prevent or reduce pollution before it is generated. In the future, increasing emphasis will be placed on innovative approaches to pollution control, which include minimizing the amount of wastes generated as well as recycling or reusing those that are produced.[22]

Future Outlook

Many factors suggest an expanding requirement for environmental health professionals: the potential health hazards associated with commercialization of new technologies (e.g. superconductors); continued efforts to evaluate and control previously identified health hazards (e.g., asbestos, radon, lead, ozone, and dioxin); ongoing attempts to characterize and mitigate the health risks associated with tens of thousands of chemicals in our environment; expanding knowledge about the subtle health effects resulting from exposures to the complex mixture of pollutants in our daily environment; and increasing concerns about the potential for adverse health effects from environmental changes, such as global warming and stratospheric ozone depletion.[15-22] Studies indicate that there is already an inadequate supply of people with appropriate education and training.[1-6,22] It seems highly probable that the shortage will become even more acute unless adequate steps are taken to rectify the situation. Despite the fact that detailed analyses are precluded by a lack of objective data, certain trends in educational and training needs seem readily apparent.

- Regardless of their specific job, members of the environmental health workforce need a firm grounding in the general principles of public health, as well as an appreciation of the rudiments of health and ecological sciences. In addition, familiarity with risk assessment and risk management procedures is increasingly important.
- It has become clear that many environmental health problems are not limited to a single medium (e.g., air, waste, soil) and therefore require multimedia and multidisciplinary approaches to understand and reduce associated risks. Thus, there will be a premium on individuals who appreciate and understand the complex interactions underlying environmental hazards, and who have the interpersonal skills to function effectively as part of a multidisciplinary team.
- The requirement for professional risk assessors and risk managers will become more acute as environmental problems escalate from local concerns to national and international issues. The economic and social ramifications of addressing these issues demand that we apply informed decision-making based on adequate scientific information about the relationships between human exposures and associated health effects.

- There is an obvious need to train medical doctors so they can effectively recognize and treat environmentally induced disease (e.g., chemical sensitivity).
- A large growth in demand is likely for qualified environmental health experts who can effectively communicate the risks of environmental exposures, as well as the associated uncertainties, to nonscientists.
- There will be a continuing and probably expanding requirement for qualified environmental health professionals capable of performing relevant research and development activities. Among the professionals who are likely to be in greatest demand are epidemiologists, biostatisticians, environmental engineers and chemists, toxicologists, and mathematical modelers (e.g., environmental fate and transport models, pharmacokinetic models).
- A general knowledge of the history of environmental health, particularly in the 20th century, as well as familiarity with the major environmental laws is becoming a requirement for many environmental health professionals working in federal agencies.

In summary, there is a current shortage and a projected demand for more and better qualified professionals in the federal environmental health workforce. These needs can only be addressed if we acknowledge the problems and take appropriate, timely steps to educate, train, recruit, and retain environmental health professionals in the federal government.

DISCLAIMER

The information presented has not been subjected to the Environmental Protection Agency's peer and administrative review. Therefore, the conclusions and opinions drawn are solely those of the authors and should not necessarily be construed to reflect the views of the agency.

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Environmental and Biological Monitoring for Lead Exposure in California Workplaces

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Abstract: Patterns of environmental and biological monitoring for lead exposure were surveyed in lead-using industries in California. Employer self-reporting indicates a large proportion of potentially lead-exposed workers have never participated in a monitoring program. Only 2.6 percent of facilities have done environmental monitoring for lead, and only 1.4 percent have routine biological monitoring programs. Monitoring practices vary by size of facility, with higher proportions in industries in which larger facilities predominate. Almost 80 percent of battery manufacturing employees work in job classifications which have been monitored, versus only 1 percent of radiator-repair workers. These findings suggest that laboratory-based surveillance for occupational lead poisoning may seriously underestimate the true number of lead poisoned workers and raise serious questions regarding compliance with key elements of the OSHA Lead Standard. (*Am J Public Health* 1990; 80:921–925.)

Introduction

The United States Public Health Service goals for 1990 include the virtual elimination of occupational heavy metal poisoning.[1] Ability to assess the extent to which occupational health programs are effective in achieving this goal rests on the existence of an adequate surveillance system.[2] Adult lead poisoning is virtually always associated with work and is due to a single causative agent. Because early lead toxicity is reversible, and patients may be asymptomatic or have vague symptoms, biological monitoring for lead by analysis of blood lead levels is particularly useful.[3] Biological and environmental monitoring for lead are well-established, and required by the California and federal Occupational Safety and Health Administration (OSHA) Lead Standards.[4] California now requires laboratories to report elevated blood lead levels to the State Department of Health Services.[5]

However, little is known regarding what proportion of workers at risk of lead exposure participate in a biological monitoring program that would allow them to be identified through a laboratory-based surveillance system. Although index cases could be identified if even a small proportion of workers were monitored, a laboratory-based system with low sensitivity would reduce the ability to evaluate the true magnitude of the problem, identify trends, and/or properly target or evaluate interventions. An estimate of the sensitivity—or ability to identify workers with elevated blood levels—of such a laboratory-based system is important, if registry data are to be used for monitoring trends or targeting interventions.

The goals of the survey herein reported were to assess monitoring practices for lead exposure in California work sites, and to evaluate the extent to which a laboratory-based occupational lead poisoning surveillance system would fulfill surveillance functions.

Methods

Selection of Sample

Four pre-existing data bases were used to identify 505 unique four-digit Standard Industrial Codes (SIC) with potential for lead use: the National Institute for Occupational Safety and Health (NIOSH) National Occupational Hazard Survey 1972–74 (NOHS)[6]; federal OSHA inspections, 1979–82, provided by Dr. John Froines (UCLA) from federal OSHA Management Information Service Data; Cal/OSHA Lead Standard violators, 1979–85, provided by the California Department of Industrial Relations; and the New York Heavy Metals Registry, 1981–85.[7] A list of employers in California in these SIC codes was obtained from the California State Employment Development Department[8]; these 236,564 reporting facilities, employing 5,837,156 individuals, comprised the sampling frame for the survey.

A weighted sampling scheme, designed to be free of systematic bias, was used to enrich the survey sample with lead-using industries[9]: seven SIC codes were selected as "special interest" industries based on past evidence of high levels of ambient lead and high proportions of workers exposed. The remaining codes were categorized into 165 "high" and 333 "low" exposure groups, based on either federal OSHA inspection data, or judgment of experienced industrial hygienists. Facilities were stratified by total number of employees. The predicted number of lead-exposed workers at each facility was estimated, based on NOHS data on the proportion of exposed workers in each SIC code. Sampling with probability proportional to size[10] was conducted, using predicted numbers of lead-exposed workers as the measure of size.

Survey of Employers

Information was obtained from employers through two questionnaires administered by mail and telephone interview. The initial questionnaire was designed to identify the presence or absence of lead use, the total number of employees at the facility, and a contact name for the second questionnaire. The second questionnaire was administered only to those employers reporting lead use, and requested a list of all processes involving lead use at the facility, the number of workers involved in each process, and information about environmental and biological monitoring practices at the facility.

Categorizing Survey Responses

Lead-using processes described by employers were categorized into 12 specific processes, and three more general exposure categories (high/medium/low) based on anticipated level and frequency of exposure as judged by eight experienced industrial hygienists. It should be noted that the exposure categories utilized in the analysis were *independent*

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of the SIC categories in the initial sampling scheme. Responses were also categorized by facility size and unionization.

Analysis

The statistical analysis incorporated information on the weighted sampling scheme to produce valid and unbiased statewide estimates of numbers and percentages.[11] The standard errors for each estimate reflect the variability that arose from taking a sample; estimation of small numbers frequently leads to large relative standard errors.

Results

Response Rates

Of the 1,165 unique facilities in the initial sample, 1,089 (93.5 percent) completed the first questionnaire. Of these, 539 employers reported using lead or lead-containing materials and 521 (96.7 percent) of this group completed the second questionnaire.

Occupational Lead Exposure

In California, 52,700 facilities (7.7 percent of all facilities) were estimated to use lead. An estimated 230,000 employees work in positions in which their employers report a lead-using process. This represents almost 2 percent of California's total work force.

Environmental Monitoring

Only 2.6 percent of facilities engaged in lead-using processes were estimated to have ever done any environmental monitoring for lead. These facilities employed an estimated 205,000 workers, 10.7 percent of California workers exposed to lead. The proportion of facilities with environmental monitoring varies directly with the number of employees (Table 1).

The percent of potentially exposed employees in positions which have had environmental monitoring performed varies according to lead-using process (Table 2). For example, less than 1 percent of workers soldering pipes or painting with lead-based paints worked in monitored positions, in contrast to 80 percent of battery manufacturing workers.

In general, the proportions of employees in monitored positions are higher in unionized than non-unionized facilities; this was not true in the 100–499 employee size category, perhaps due to the large number of monitored non-unionized electronics industry solderers in this size category (data available on request to author).

TABLE 1—Estimated Number of Facilities with Lead Use in California, and Estimated Number with any Environmental Monitoring of Exposure to Lead, by Facility Size

Facility Size	Facilities with lead use N	Facilities with any environmental monitoring N	% (SE)
1–19 employees	33,410	32	0.10 (0.04)
20–99 employees	12,753	292	2.29 (1.23)
100–499 employees	4,112	405	9.85 (4.10)
500 or more employees	2,402	630	26.22 (7.12)
Total	52,677	1,359	2.58

Of those workers with high/daily exposures, 37 percent work in positions which had been monitored, versus only 2.6 percent in positions with high/weekly exposures. Radiator repair was the most commonly reported process with high/daily exposures for which environmental monitoring had never been performed.

The characteristics of process, size, and unionization appear to be interrelated. For example, an estimated 88 percent of radiator repair employees work in small (1–19 employees) facilities, while 87 percent of battery manufacture workers are employed in larger (100–499 employees) facilities. Less than .6 percent of the smallest facilities' workers are unionized, versus nearly 50 percent of those at the largest size facilities. A significant proportion of environmental monitoring appears to be done by company-employed industrial hygienists. At large facilities, this was true for 80 percent of monitored workers. For the smallest companies, about 57 percent of monitoring was conducted by private contractor, 19.7 percent by insurance companies, and 23.2 percent by Cal-OSHA (compliance or consultation). Less than one-half of monitored positions had been evaluated in the year preceding the survey; in over 17 percent, monitoring was most recently performed in 1980.

Biological Monitoring

Only 1.4 percent of facilities engaged in lead-using processes, and about 2.6 percent of potentially lead-exposed workers were estimated to have routine biological monitoring programs. Marked variation in biological monitoring practices was noted among the seven "special interest" SIC groups (Table 3). Fifty-three percent of the blood lead analyses performed as part of routine biological monitoring programs are performed by California laboratories, with the rest being done by out-of-state laboratories. The proportion of employees receiving biological monitoring varies with size of facility and potential for high lead exposures (Table 4).

Discussion

There are several possible limitations in the methodology employed in this survey. Results were based exclusively on data from employer self-reporting of lead use, number of workers exposed, and monitoring practices. No attempts were made to validate the information received from employers.

It is possible that some employers did not report actual use of lead on the first survey, and were subsequently excluded; this should not have led to an underestimate of the proportion of workers monitored.

Workers conducting different job activities may have been lumped together as "monitored", even if only one activity in an area has actually been assessed. Also, full- and part-time workers may have been lumped together. Some battery manufacturers included clerical workers among those potentially exposed. In several facilities, these employees received biological monitoring, but none of their positions were environmentally monitored. This may explain discrepancies between environmental and biological monitoring prevalence (e.g., 79 percent of battery workers are in environmentally monitored positions, while 95 percent are biologically monitored).

In the absence of actual exposure data for each work site, the extent to which monitoring actually should be conducted in the sampled facilities cannot be determined. It is possible that monitoring was not done because exposures are below those levels that warrant it. Although our survey

TABLE 2—Estimated Number of Lead-exposed Employees, by Occurrence of Environmental Monitoring at any Time in the Past by Type of Lead-using Process

	Employee working in position where environmental monitoring ever done?				
	Yes		No		
Lead-using Process	N	% (SE)	N	% (SE)	Total employees exposed to lead N
Soldering, except pipes and sheets	18,931	16.59 (3.98)	95,169	83.41 (3.98)	114,100
Dispensing leaded gasoline	129	0.42 (.42)	30,829	99.58 (0.43)	30,958
Soldering pipes and sheets	116	0.52 (0.31)	22,234	99.48 (0.31)	22,350
Cable cutting and splicing	374	2.72 (3.52)	13,393	97.28 (3.52)	13,767
Painting with lead-based paint	92	0.72 (0.53)	12,601	99.28 (0.53)	12,693
Painting with lead-based inks	0	0	7,496	100.00	7,496
Casting or melting lead or jointing	975	21.71 (7.86)	3,517	78.29 (7.86)	4,492
Radiator repair[a]	49	1.14 (0.79)	4,271	98.86 (0.79)	4,320
Welding metal alloys or surfaces painted with lead based paints	260	6.79 (2.55)	3,844	93.21 (2.55)	4,124
Machining, grinding or sanding surfaces painted with leaded paints	254	7.92 (7.23)	2,954	92.08 (7.23)	3,208
Battery manufacture	1,477	79.62 (8.65)	378	20.38 (8.65)	1,855
Other process with lead use	1,814	18.01 (6.41)	8,258	81.99 (6.41)	10,072
Total	24,491	10.67	204,944	89.33	229,435

[a] Includes workers in SICs 7528 and 7539

instrument did not directly assess this possibility, it seems unlikely that this would be true in the "high" exposure categories. There is no evidence that workers in smaller facilities are likely to have lower exposure than those in larger plants, suggesting that the lack of monitoring in small facilities is due to factors other than lack of exposure.

Few other data on biological and environmental monitoring are available. Ratcliff, Halperin, *et al.*[12] utilized data from NOHS to demonstrate that there is no consistent evidence that workers potentially exposed to chemical hazards are more likely to receive screening than other workers, but that such screening is more likely in large facilities. This is consistent with the results of the current survey.

However, the NIOSH study estimated that almost 25 percent of lead-exposed workers receive periodic monitoring, and that 18 percent receive blood tests—a substantially higher proportion than seen in this survey. The NOHS survey was done prior to promulgation of the OSHA Lead Standard; it asks about any blood test, without reference to specific biological monitoring for a particular substance. Also, the NOHS appears to have counted all employees as receiving blood tests if any did.[6] In contrast, the current study asked about monitoring in workers specifically identified as working in lead-using jobs. Therefore, the results reported here are likely to constitute a more accurate assessment of monitoring for lead in lead-exposed workers.

The lack of environmental or biological monitoring in a majority of potentially lead-exposed workers may result in inability to identify workers or work sites where interventions could prevent cases of occupational lead poisoning. The widespread lack of monitoring makes surveillance for trends, assessment of the true magnitude of the problem, or evaluation of the efficacy of interventions virtually impossible. A laboratory-based surveillance system for lead over-exposure would be limited to the identification of two categories of workers: those with overt clinical signs of lead poisoning for whom an alert clinician has ordered a blood lead test, and the small minority of workers who participate in a routine monitoring program. These categories are likely to represent two extremes: the very worst cases, and those who are likely to have more access to medical and industrial hygiene services by virtue of being enrolled in a monitoring program. The large majority of lead-exposed workers remain excluded, and thus inaccessible to the surveillance system.

These limitations do not undercut the ability of a laboratory-based surveillance system to identify important index cases of lead poisoning.[13]

Our data imply a significant lack of compliance with the monitoring provisions of the OSHA Lead Standard, which were constructed specifically to facilitate timely interventions. The relatively high prevalence of monitoring in battery manufacture may be attributable to past California OSHA compliance efforts specifically directed at biological monitoring activities in this industry.* Implementation of recommendations[14] that would require employers to report results of medical examinations and exposure monitoring to OSHA could complement laboratory-based surveillance and assist OSHA in identifying industries and employers who appear to be out of compliance with monitoring requirement.

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*Personal communication, J. Simonowitz, RN, Cal/OSHA Medical Unit.

TABLE 3—Estimated Number of Employees Who are Receiving Routine Biological Monitoring by SIC Code

Lead-using SIC Codes	Employees potentially exposed to lead[a] N	Employees receiving routine biological monitoring N	% of exposed (SE)
Estimated exposure below action level[b]	107,322	997	0.93 (0.46)
Estimated exposure above action level, excl. below[b]	88,262	2,475	2.80 (1.08)
1711: Plumbing, heating and air conditioning	22,742	0	0
3341: Secondary smelting non-ferrous metals	393	132	33.59 (12.84)
3691: Storage battery manufacture	1,850	1,762	95.25 (3.68)
3731: Shipbuilding and repair	1,089	477	(43.79) (28.07)
7538: Automotive repair shops	6,561	1	0.02 (0.02)
7539: Radiator repair shops[c]	903	70	7.95 (3.95)
7692: Welding repair	312	0	0
Total	229,434	59,142	2.58

[a] Based on employer survey report.

[b] Based on industrial measurements from fed/OHSA or judgment of industrial hygienist.[9]

[c] Companies in this SIC without "radiator" in the name excluded.

Approximately 12 percent of potentially lead-exposed individuals are in construction jobs which are not covered by the Lead Standard.** In this segment, monitoring is extremely limited—for example, no plumbing employees were reported to have biological monitoring for lead, and less than 1 percent of those painting with lead-based paints worked in environmentally monitored positions. Yet reports indicate a serious continued potential for lead poisoning in the construction industry.[13]

Our findings suggest a need for new strategies for enforcement and enhanced compliance with the existing occupational lead standard, as well as a need for expansion of the standard to cover construction workers. Increased employer and worker education regarding lead and the lead standard are also warranted. Education and targeted compliance may be particularly important in small and non-unionized shops.

In conclusion, only a small proportion of the large number of potentially lead-exposed workers in California work in positions which have ever had industrial hygiene monitoring; an even smaller proportion participate in a routine biological monitoring program. Workers in small and non-unionized facilities are especially unlikely to participate in any type of monitoring program. The failure of employers to establish legally mandated environmental and biological monitoring programs severely limits the ability of laboratory-based surveillance programs to adequately fulfill critical functions of occupational disease or exposure surveillance. This, in turn, severely impedes our progress in the prevention and ultimate elimination of occupational lead poisoning.

TABLE 4—Estimated Percent of Lead-exposed Employees Receiving Routine Biological Monitoring by Highest Level of Potential Exposure Reported at Their Workplace and by Facility Size

	Number of employees at facility				
Level of exposure	1–19	20–99	100–499	>500	All facilities
High	0.52	9.90	48.99	15.90	16.34
Moderate	0	0	8.38	1.01	1.16
Low	0	0	0.24	0.10	0.05
All facilities	0.06	0.55	11.27	4.09	2.58

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**The construction industry is required to meet other OSHA standards limiting lead exposure to 200μg/m^3, but is not required to provide air or blood monitoring.

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Accelerated Nursing Program at JHU Quadruples Enrollment in 2nd Year

The shortage of nurses in the United States will be eased by former park rangers, Peace Corps volunteers, teachers, flight attendants, and even an ex-circus clown, according to word received from the Johns Hopkins Medical Institutions. Enrollment in an accelerated nursing program there has quadrupled during its second year.

The program, initiated last year in response to the nationwide need for high quality nurses, allows individuals who already hold a bachelor's degree in some other field to earn a bachelor's in nursing in just 15 months—nearly half the time it ordinarily takes to become a registered nurse.

The accelerated program was established to attract a new pool of bright students into the nursing profession by providing an intensified curriculum that responds to their academic and clinical needs. While 13 in the current class have just graduated from college, the majority of students are choosing nursing after working at a previous career, such as those listed above.

The current class of 60 future nurses at JHU includes 10 men. Students range in age from 20–51 years, come from 17 different states, and hold degrees from Stanford, Duke, Antioch, Smith, the University of Virginia and the University of Chicago, among other institutions. Ten members of the new class hold master's degrees.

More than one in every 10 budgeted positions for registered nurses in US hospitals is vacant at the present time, and as many as one in five budgeted nursing home positions is empty. It has been estimated that it would take about 130,000 full-time registered nurses to fill vacant positions in hospitals and nursing homes across the nation.

For further information, contact Johns Hopkins Medical Institutions, Office of Public Affairs, 550 North Broadway, Suite 1100, Baltimore, MD 21205. Tel: (301) 955-6680.

Field Comparison of Several Commercially Available Radon Detectors

R. WILLIAM FIELD, MS, AND BURTON C. KROSS, PHD

Abstract: To determine the accuracy and precision of commercially available radon detectors in a field setting, 15 detectors from six companies were exposed to radon and compared to a reference radon level. The detectors from companies that had already passed National Radon Measurement Proficiency Program testing had better precision and accuracy than those detectors awaiting proficiency testing. Charcoal adsorption detectors and diffusion barrier charcoal adsorption detectors performed very well, and the latter detectors displayed excellent time averaging ability. Alternatively, charcoal liquid scintillation detectors exhibited acceptable accuracy but poor precision, and bare alpha registration detectors showed both poor accuracy and precision. The mean radon level reported by the bare alpha registration detectors was 68 percent lower than the radon reference level. (*Am J Public Health* 1990; 80:926–930.)

Introduction

Radon provides the primary source of ionizing radiation exposure in man, imparting a greater effective dose equivalent to the average individual than other natural and man-made radiation sources combined.[1] Although radon has always existed in the environment, it did not become a major public health concern until 1984, when high radon levels were discovered in eastern Pennsylvania homes.[2] In 1986, the United States Environmental Protection Agency (EPA) estimated that up to 20,000 lung cancer deaths per year in the US may be due to exposure to radon.[3] The news coverage, public information campaigns, and reported health consequences that followed these discoveries initiated the cascade of public interest, awareness, and anxiety that surrounds radon today.

Public concern over radon in individual dwellings has resulted in a rise in the number of primary companies that provide radon measurement services to over 700 companies nationwide. Although the US does not have a national program to certify radon measurement companies, the National Radon Measurement Proficiency (RMP) Program within the Radon Division of the US EPA Office of Radiation Programs determines the accuracy of radon detectors on a voluntary basis and informs the public of these results upon request.[4] The majority of states have no ongoing quality assurance program for radon testing enterprises operating within their borders. Iowa has recently initiated a certification program to set minimum requirements for radon testing and analysis,[5] but will still rely on the federal government to actually test the radon measuring devices. In most cases, before Iowa certifies companies for radon testing, the State Department of Public Health requires that companies pass National RMP Program proficiency testing. Nevertheless, if companies enroll in the National RMP Program for the first time, then certification can be granted, pending review of their application and proficiency testing which allows some companies to market their radon detecting devices for up to a year prior to completion of proficiency testing.

After a company enrolls in the proficiency program, it must submit a specified number of detectors (e.g. five charcoal canisters) to the EPA for testing. These detectors are exposed in a calibration chamber to known levels of radon and radon decay products and returned to the company for analysis. The radon level in the chamber is not revealed to the company. A company is judged proficient if the mean of the absolute value of the relative measurement errors (MARE) of all exposed detectors for a particular method (activated charcoal adsorption, alpha track detection, etc.) is less than or equal to 0.250. In addition to the above proficiency testing, the EPA performs intermittent blind testing of commercially purchased detectors. A company that fails to pass either the announced or blind testing will not pass proficiency for that round. However, the company may participate in the next round of testing which occurs at intervals of up to a year or longer.

The majority of radon detectors purchased in the US are used for performing an initial radon screening measurement, which can quickly and inexpensively determine if elevated radon levels exist in a home. If screening is performed in adherence to EPA radon measurement protocols,[6,7] then this initial measurement will usually represent the maximum radon concentration to which the occupants of the home may be exposed. It is crucial that the initial screening measurement be accurate, because this result dictates whether additional testing is necessary.

The National RMP Program uses only a controlled calibration chamber to test radon-detecting devices, which may not reflect conditions in a dwelling. For example, the accuracy and precision of the radon measurement in a dwelling may be affected by temporal radon variations, changes in particulate (dust) concentration and size, air movement, humidity, temperature, and degree of radon progeny equilibrium, whereas in a calibration chamber the radon concentration and environmental parameters are highly controlled. Because of these potential differences, it is not known whether the accuracy measured in a calibration chamber can be extrapolated to the field.

This study determines the accuracy and precision of several commercially available radon detectors in a field setting. The accuracy and precision of detectors that have passed National RMP Program testing are compared to those that are awaiting proficiency testing.

Methods

The study site was a basement bedroom (see Appendix A) located in a ranch style home in southeastern Iowa. This house was selected based on the following criteria:

- Its observed radon concentration reflects the mean radon level of 10.5 pCi/L found in a recent screening

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From the University of Iowa, Institute of Agricultural Medicine and Occupational Health. Address reprint requests to R. William Field, MS, Department of Preventive Medicine and Environmental Health, Institute of Agricultural Medicine and Occupational Health, College of Medicine, Oakdale Campus, University of Iowa, Iowa City, IA 52242. Dr. Kross is Assistant Professor in the Department. This paper, submitted to the Journal October 23, 1989, was revised and accepted for publication April 12, 1990.

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study of 600 Iowa homes.* Prior radon sampling at the experimental site had shown that the basement bedroom radon concentration averaged 11 pCi/L during the winter months.

- The air in the home was conditioned with a humidified central forced-air heating system which maintained the relative humidity and temperature at 38–47 percent and 20°C, respectively.
- None of the four occupants (two adults and two children) smoked.
- Closed house conditions as described by EPA protocols could be monitored.

Radon detectors from six companies were chosen for this study (Appendix B). Criteria for detector selection included: large sales volume in Iowa, state certification or pending state certification, and ease of availability to consumers. In addition, detectors from two other sources not readily available to shoppers were chosen based on either ability to produce a true integrated average radon measurement (in the case of the electret ion chamber from Rad Elec, Inc.) or, widespread use in radon screening (in the case of the EPA's charcoal adsorption canister).

Radon detectors from each company listed in Appendix B were purchased from various southeast Iowa commercial sources, including hardware stores, discount stores, pharmacies, grocery stores, and a heating supply company. Placement of the radon detectors was performed in accordance with EPA protocols for screening measurements.[6,7] All the detectors were placed a minimum of 10.2 cm away from other objects, including other radon detectors. Except for normal entering and exiting, all windows and exterior doors in the home were closed 12 hours prior to and during the testing period; fans and ventilation systems that bring in outside air or exhaust house air were not operated. An occupant activity log was maintained to document maintenance of closed house conditions.

A femto-Tech continuous radon monitor (CRM) was positioned in the center of a 4 m^2 platform. The platform, located on a queen size bed, was 0.9 m above floor level. Radon detectors from all but one company were evenly distributed around the CRM. As per the accompanying instructions, the detectors from Air Check, Inc. were suspended from the ceiling approximately 30 cm above the other detectors.

The femto-Tech radon monitor was calibrated before the study period commenced against a femto-Tech "master" unit. The "master" unit was calibrated in the EG&G Mound Technologies, Inc. Radon Chamber which participated in the cross comparison network of US Department of Energy and US EPA radon chamber facilities. The accuracy of the femto-Tech CRM is estimated to be within 10 percent. The CRM provided hourly printouts of the radon concentrations in the room and was operating 24 hours prior to and during the entire seven day study period which initiated at 1100 hrs on March 18, 1989 and terminated at 1100 hrs on March 25, 1989.

The radon measurement periods and numbers of detectors exposed from each company are listed on Table 1. With the exception of the electret ion chambers from Rad Elec, Inc., these measurement periods were based on the optimal exposure duration, as indicated in the instructions that accompanied each detector. Five electret ion chambers were exposed for each of the three exposure periods in order to evaluate the homogeneity of the bedroom radon concentration. Although there were three different radon measurement initiation dates, all measurements were terminated at 1100 hrs on March 25, 1989. One detector from each company and three detectors from Rad Elec, Inc. were used as field control detectors which remained sealed and stored in a low radon environment during the course of the study. The controls were labeled in identical fashion to the exposed detectors to ensure identical processing and mailed back to the companies with the other detectors on March 28, 1989. The measurement results for each type of detector were compared to the reference values established for the various exposure periods by the CRM.

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*Kross BC, Vust LJ, Field RW: Factors associated with elevated radon levels in rural areas. Manuscript in preparation.

TABLE 1—Precision and Accuracy of Radon Detectors

Company	Number of Detectors	Exposure (days)	Radon Level Mean ± S.D. (pCi/L)	*Coefficient of Variation (%)	**Mare	Reference Radon Concentration Mean (pCi/L)
Rad Elec, Inc.	5	7	10.2 ± 0.4	3.9	0.045	10.6
American Radon Services	15	7	10.8 ± 0.8	7.5	0.057	10.6
Air Check, Inc.	15	7	11.4 ± 1.1	9.6	0.098	10.6
The Radon Project	15	7	10.5 ± 2.7	25.9	0.169	10.6
Rad Elec, Inc.	5	5	10.1 ± 1.2	11.8	0.091	10.6
Terradex	15	5	3.4 ± 1.7	50.6	0.679	10.6
Rad Elec, Inc.	5	2	9.6 ± 0.5	5.1	0.052	9.2
Ryan Nuclear Labs	15	2	11.0 ± 0.8	7.7	0.198	9.2
Key Technology	15	2	10.3 ± 0.8	7.5	0.136	9.2
EPA	15	2	11.6 ± 0.5	4.4	0.264	9.2

*The coefficient of variation was calculated using a standard deviation carried out to three decimal places.
**The mean of the absolute values of the relative errors (MARE) must be ≤ 0.250 to pass proficiency. Its calculation is shown below.

$$\text{MARE} = \frac{\sum_{i=1}^{n} \frac{|M_i - T_i|}{T_i}}{n}$$

n = number of detectors exposed
M_i = measured value for detector i
T_i = target value for detector i (reference value in this case)

Results

A plot of the hourly measurement results obtained from the CRM is shown in Figure 1. The radon level in the bedroom showed considerable variation, especially during the last two days of the study which was probably related to increased ventilation rates in the basement. The occupant activity log notes that the children living in the home frequently opened the basement door leading to the outside during the evening of March 23 and the afternoon of March 24, 1989.

The measurement results for each type of detector are listed in Table 1. The measurements for the individual detectors from each company were reduced to the mean, standard deviation, coefficient of variation and MARE (Table 1) as a measure of the detectors' accuracy and precision.

The relatively small standard deviations within the three groups of electret ion chambers exposed for each time period indicate a fairly homogeneous radon concentration in the measurement area.

The MARE for the seven-day exposure detectors were all within the National RMP Programs requirement of ≤ 0.250.[4] The precision for the seven-day exposure duration detectors was below the 10 percent coefficient of variation as per the radon measurement protocol guidelines published by the EPA,[6] except for the radon detectors from the Radon Project which had a coefficient of variation of 25.9 percent.

Terradex's five-day exposure duration bare alpha track registration devices (BARDs) yielded a MARE in excess of the EPA's accuracy guidelines (≤ 0.250 required for accuracy) and a coefficient of variation in excess of the EPA's BARD radon measurement protocol precision guidelines[7] (≤ 20 percent required for precision).

The two-day exposure duration detectors from Ryan Nuclear Labs and Key Technology were both within the EPA guidelines for accuracy[4] and precision.[6]

Figure 2 shows the distribution of individual test results for each company and their relationship to the radon reference level.

The reported radon level for the blanks submitted to the companies were all < 0.5 pCi/L.

Discussion

The radon detectors that have already passed the National RMP Program displayed reasonable accuracy and precision when compared to the reference radon level generated by the continuous radon monitor. The diffusion barrier charcoal adsorption (DBCA) detector from American Radon Services and Air Check, Inc. appeared to be the best over-the-counter integrators of radon, yielding accurate results and acceptable precision for the week-long exposure period.

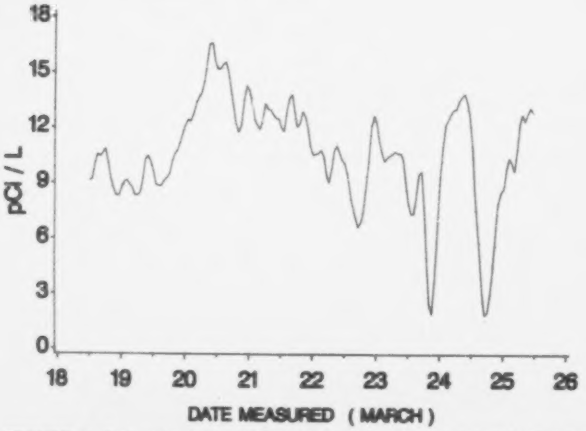

FIGURE 1—Interpolated Hourly Plot of the Radon Measurements Obtained from the Continuous Radon Monitor for the Period 1100 hrs March 18 to 1100 hrs March 25, 1989

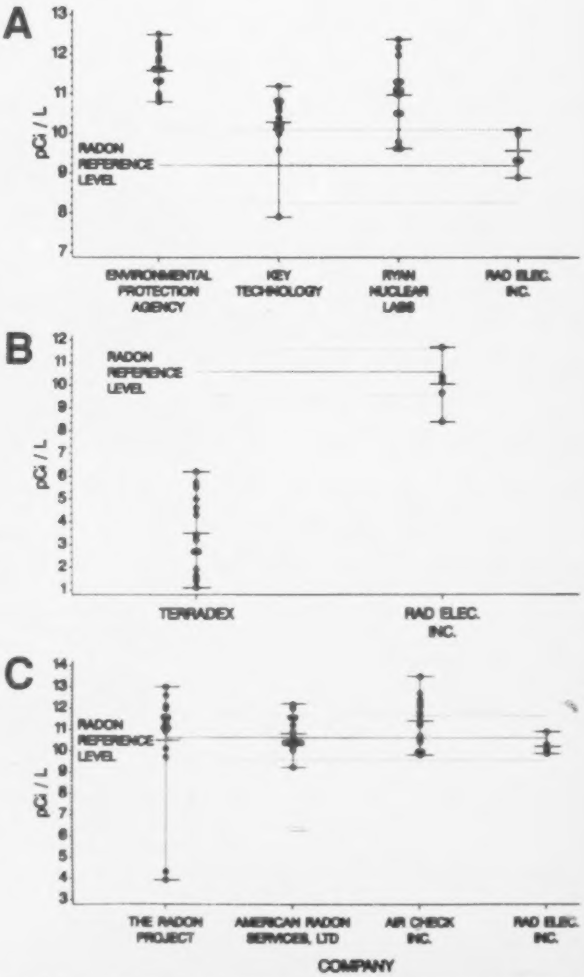

FIGURE 2—Comparison of the companies' individual detector results with the continuous radon monitor's reference value for the three exposure periods. Two (A), five (B), and seven (C) day exposure periods were initiated at 1100 hrs on March 18, March 20, and March 23, 1989, respectively. All three exposure periods ended on March 25, 1989 at 1100 hrs. The solid horizontal lines represent the radon reference values while the dotted horizontal lines indicate the confidence interval for the estimated accuracy of the continuous radon monitor. Each circle represents an individual radon detector measurement result. The means for the radon values reported by each company are indicated on the vertical range lines.

The accuracy of the charcoal adsorption (CA) detectors from Key Technology, Ryan Nuclear Labs, and the EPA was not as good as that attained for the DBCA detectors mentioned above, although the MARE from Ryan Nuclear Labs and Key Technology detectors was within 0.250. The EPA's CA detector accuracy was just above a MARE of 0.250 at 0.264. All three companies reported higher radon levels than the radon reference value for the 48-hour exposure period. The results from these detectors seem to be weighted by radon levels over the last 12 hours of the exposure period which averaged 11.9 pCi/L. These results are not unexpected, since the CA detectors do not integrate radon levels as well as the DBCA detectors. Despite the extreme fluctuations in radon levels, the two-day detectors performed reasonably well.

The detectors from the two companies awaiting proficiency testing did not perform well. Radon measurements using Terradex's BARD resulted in both poor accuracy and precision. Although the reference value was 10.6 pCi/L for the five-day exposure period, nine of the 15 detectors reported radon levels below 4 pCi/L (Figure 2B). The EPA recommends follow-up testing only if a screening radon test is above 4.0 pCi/L. If these detectors are representative of all Terradex's BARDs, then the majority of consumers with home radon levels and ambient conditions similar to the study site would theoretically receive radon measurement results below the EPA's action level of 4.0 pCi/L. This has significant public health implications, since these consumers would not perform follow-up testing or possible subsequent mitigation.

Several factors could influence BARD measurement variability, including ratio of radon daughters to radon in air, differences in the number of tracks used as background, locating objects less than 8 cm from the detector surface, variations in etching conditions and differences in readout.[7]

The results from the Radon Project's charcoal liquid scintillation (CLS) detectors underscore the importance of measuring precision. These detectors showed acceptable accuracy but poor precision (see Table 1). Since the National RMP Program has no requirements for precision the detectors would have passed proficiency, even though their coefficient of variation (25.9 percent) was over the EPA guidelines (≤10 percent) for precision. Thirteen detectors produced measured radon levels between 9.7 pCi/L and 13.0 pCi/L, but two detectors yielded results of 3.9 pCi/L and 4.3 pCi/L (see Figure 2C). The two lower results may be due to poor quality control of detector packaging. The two detectors that reported the highest (13.0 pCi/L) and the lowest radon level (3.9 pCi/L) both had loose vial caps upon initial examination. Loose caps compromise the detectors' seal, allowing both radon and water vapor to enter into the detector prior to actual deployment. Thus, the measured radon level could either be falsely elevated or lowered, depending on conditions that existed prior to detector use. For example, if the detectors with loose caps were stored in a high humidity environment, water molecules could reduce the number of radon adsorption sites on the charcoal, resulting in a lower measurement. On the other hand, if the detectors were stored in an area with high radon levels prior to deployment, a higher measurement could ensue.

In addition to the problems with the loose caps, six out of the 16 detectors purchased had diffusion barriers that had fallen out of the vial caps. The diffusion barrier is an integral part of this detector, allowing it to be marketed as a time-averaging device. It is unlikely that a consumer would search through the packaging material to replace a missing diffusion barrier. In this experiment all of the missing barriers were replaced into the vial caps. Securing the diffusion barrier to the cap would improve performance of this detector.

Finally, two of the 16 detector caps contained a second diffusion barrier which was not removed for our field experiment. These two detectors yielded results of 4.3 pCi/L and 11.4 pCi/L, compared to the reference CRM value of 10.6 pCi/L. Without further testing it is impossible to assess whether or not the extra vapor barrier affected the radon readings delivered by the detectors.

We offer the following recommendations to improve both the precision and accuracy of commercial radon detectors:

- States should require that companies pass proficiency testing by either the EPA or the state prior to selling their products. Interim or temporary certifications should not be granted while proficiency testing is being performed.
- The National RMP Program should require that detectors also pass a nominal precision criterion, as recommended in the Indoor Radon and Radon Decay Product Measurement Protocols[6,7] before passing proficiency testing.
- The National RMP Program should increase the rate at which it can test the detectors to accommodate the proliferating numbers of radon detecting companies.
- The National RMP Program should include occasional field testing of radon detectors.
- Radon chamber conditions should be diversified to better reflect the variety of actual home conditions.

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APPENDIX A

Study Site in Southeastern Iowa

The bedroom has a poured concrete floor, and the south and east outside walls are constructed of concrete block. The east wall is about 1.5 m below grade while the south wall is even grade. The west and north walls are common to the rest of the basement. The floor covers an area of 14.4 m^2 and the ceiling height is 2.2 m, resulting in a total room volume of 31.7 m^3. There is a heating vent with an air flow rate of 0.12 m^3/min located 2 m above the floor on the northwest wall. Air flow rates in the study area averaged below 0.015 m/min. A well insulated window with blind is located in the south wall, and both windows and blind remained closed during the course of the study. However, the door to the room remained open so that the room could equilibrate with basement temperature, relative humidity, and radon concentrations.

APPENDIX B

Commercially Available Radon Monitors Used in Detector Intercomparison

Company, City	Measurement Method	Detector Type
Air Check, Inc., Arden, NC	Activated charcoal adsorption	Diffusion barrier charcoal loaded bag*
American Radon Services, Ltd., Ames, IA	Activated charcoal adsorption	Diffusion barrier charcoal adsorption canister*
Key Technology, Jonestown, PA	Activated charcoal adsorption	Charcoal adsorption canister*
The Radon Project, Pittsburgh, PA	Activated charcoal adsorption	Diffusion barrier charcoal adsorption liquid scintillation vial**
Ryan Nuclear Labs, W. Jefferson, OH	Activated charcoal adsorption	Charcoal loaded bag*
Terradex, Glenwood, IL	Alpha track detection	Bare alpha track registration device**

*Indicates company has passed Round 5 of the National Radon Measurement Proficiency Program for that particular detector.

**Indicates company did not participate in Round 5 of the National Radon Measurement Proficiency Program for that particular detector, but did participate in Round 6 of testing and is awaiting results.

Sites Listed for Nurse Scholars to Repay Educational Obligation

Recipients of scholarships for the undergraduate education of professional nurses are required upon graduation to serve at least two years in specified shortage sites. The Health Resources and Services Administration has announced a list of certain facilities where such recipients may repay their obligation. These include an Indian Health Service health center, a Native Hawaiian health center, a public hospital, a community or migrant health center, a nursing facility, a rural health clinic, or a health facility determined by DHHS to have a critical shortage of nurses. This announcement, which was published in the May 25 *Federal Register*, defines critical shortage facilities to include:

- All rural hospitals (classified by Medicare and Medicaid),
- All "disproportionate share" hospitals (those determined by Medicare and Medicaid as serving a disproportionate number of low income patients),
- Home health agencies approved for Medicare and Medicaid reimbursement,
- State and local health departments,
- Indian Health Service hospitals and other IHS facilities approved for Medicare and Medicaid reimbursement,
- Veterans hospitals, and
- Military health care facilities of the Department of Defense.

More information is available from the Division of Student Assistance, Bureau of Health Professions, 5600 Fishers Lane, Rm 8-48, Rockville, MD 20857. Tel: (301) 443-1173.

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HRSA also announced that it is accepting FY 1991 grant applications for advanced nurse education. Applications must be submitted by October 1 to the Grants Management Officer, Bureau of Health Professions, 5600 Fishers Lane, Rm 8C-26, Rockville, MD 20857. Tel: (301) 443-6960.

Elevated Blood Lead in California Adults, 1987: Results of a Statewide Surveillance Program Based on Laboratory Reports

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AND KENNETH W. KIZER, MD, MPH

Abstract: California medical laboratories that test for blood lead are required to report results exceeding 1.21 µmol/L (25 µg/dl). Between April and December 1987, the California Department of Health Services received 3,077 blood lead reports from 34 laboratories for 1,293 civilian, non-institutionalized adults.

Approximately 1 percent of all reports exceeded 3.87 µmol/L (80 µg/dl), 7 percent exceeded 2.42 µmol/L (50 µg/dl), and 21 percent exceeded 1.93 µmol/L (40 µg/dl). Individuals tested were overwhelmingly male (94 percent), disproportionately Hispanic surnamed (44 percent), and most often residents of Los Angeles County (81 percent).

Workers in lead smelting, battery manufacturing, and brass foundries accounted for nearly 80 percent of reports. Construction, radiator repair, pottery and ceramics manufacturing, and gun firing ranges accounted for the remainder. All adults with reports of ≥2.90 µmol/L who were contacted reported an occupational exposure. Approximately half were not in routine medical monitoring programs. Despite OSHA standards, elevated blood lead with the potential for serious acute and chronic lead poisoning in California adults remains a significant public health and major occupational health concern. (*Am J Public Health* 1990; 80:931–934.)

Introduction

Under a state law in effect since January 1, 1987, California medical laboratories performing tests for blood lead have been required to report personal identifiers and blood lead levels of individuals with tests exceeding 1.21 µmol/L (25 µg/dl), irrespective of age. The California Department of Health Services (CDHS) was charged with notifying laboratories, establishing a proficiency program for laboratories, designing report forms, and tabulating the reports. Over 95 percent of blood lead reports received from this program in 1987 were for persons greater than 16 years of age, and are the basis of this report.

Workplace exposures to lead are regulated under a standard issued in 1978 by the federal Occupational Safety and Health Administration.[1] The standard established an exposure limit of 50 $\mu g/m^3$ for airborne lead exposures for an 8-hour work day, and required employers to provide training, respiratory protection, work clothes changes, shower facilities, and a medical surveillance program, including annual physical examinations and periodic blood lead tests to eligible employees. Workers in agriculture and construction are currently excluded. The standard requires that workers with blood lead levels exceeding 1.93 µmol/L be re-tested bimonthly and those exceeding 2.90 µg/dl (or average 2.41 µmol/L on three previous tests) be immediately transferred and placed in jobs with low or no exposure.

This article describes initial results from a pilot program for surveillance of blood lead reports from medical laboratories and from follow-up of adults with reported blood lead levels of 2.90 µmol/L.

Methods

Patient identifiers, demographics, blood lead level, and other relevant information were reported by laboratories on specially designed forms. If the gender field of the registrant was blank, one was designated on the basis of first name of the registrant. An indicator of Hispanic surname was also designated. Industry of employment was based on an assignment of the Standard Industrial Classification (SIC)[2] code for reports that included an employer identifier. Employer name and address on the report form were matched to listings in the 1987 California Manufacturers Directory.[3] The SIC code for the primary business activity was then assigned to the report. Due to a paucity of complete data, occupation was not coded.

Follow-up of Elevated Blood Lead Reports

A working draft protocol for follow-up of reports was implemented for cases exceeding 2.90 µmol/L. Individuals and their physicians and employers were traced, and structured telephone interviews were administered to determine: the level of direct medical supervision, if any; work history and source of exposure, occupational and/or non-occupational; number of household contacts less than 7 years of age; number of co-workers exposed to lead; use of personal protective equipment and hygienic practices at work; and application of medical removal requirements of the federal OSHA lead standard.

An information packet was sent to the worker, his/her physicians, and employer.[4-6] Subsequent blood lead reports were tracked until levels fell below 1.93 µmol/L; workers were re-contacted if their subsequent blood lead levels abruptly increased.

Employers were informed of free industrial hygiene services available from the state OSHA Consultation Services, or encouraged to seek private consultants for technical consultation. Apparent egregious violations of the OSHA lead standard were channeled to appropriate enforcement agencies for follow-up. A recommendation to screen children and/or household contacts for elevated blood lead was forwarded to the state and local health officials when household contacts included children at risk of parental take-home exposures or non-occupational activities, or when an adult's exposure was non-occupational.

Laboratory Certification

A proficiency program was established by CDHS, and, according to its protocol, laboratories are certified as proficient if lead concentrations are reported within 15 percent of

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target values for concentrations less than 1.93 μmol/L, or within .29 μmol/L of target values for concentrations greater than 1.93 μmol/L in 75 percent of at least nine reference samples.

Results

Blood Lead Distributions

Between April and December 1987, CDHS received 3,077 blood lead reports from 34 laboratories for 1,293 civilian, non-institutionalized adults, 16 years and older. Blood lead level was filled in on 3,024 report forms, and 2,643 reports were greater than 1.21 μmol/L (Table 1). Approximately 60 percent of individuals had only one test, 14 percent had two tests, 5 percent had three tests, and 22 percent had four or more tests in 1987.

Of reports greater than 1.21 μmol/L, approximately 1 percent (24) were equal or greater than 3.87 μmol/L, 7 percent (198) were equal or greater than 2.42 μmol/L, and 25 percent (649) were equal or greater than 1.93 μmol/L. Counting individuals once, but at their highest blood lead level in 1987, 355 individuals (31 percent) had a peak blood lead level of 1.93 μmol/L or greater; 124 (11 percent) peaked at 2.42 μmol/L or greater; 56 (5 percent) peaked at 2.90 μmol/L or greater; and 16 (1 percent) had peak levels at or above 3.87 μmol/L (Table 1).

Distribution by Age, Sex, Hispanic Surname, and Residence

The age distribution was that of a working population with 32 percent in their fourth decade (Table 2). Individuals were overwhelmingly male and disproportionately Hispanic surnamed. The blood lead distribution was similar in those with and without Hispanic surnames. Hispanics comprise approximately 24 percent of California's population. Of reports with known zip code, 81 percent were of residents of Los Angeles County (Table 2).

Distribution by Industry

Ninety-one employers were identifiable by name, and accounted for 2,521 (82 percent) reports. SIC codes were not obtainable for 1,109 (36 percent) of reports because the employer identifiers were blank or did not match entries in the California Manufacturer's Directory (Table 3). Based on the laboratory name (indicating that an employer-operated laboratory performed the blood lead analysis), three employers apparently accounted for 67 percent (2,070) of reports. Apparently, the reporting was done in the context of employer-based medical screening program's mandated by the OSHA lead standard. Three employers engaged in secondary lead smelting, 11 employers engaged in battery manufacture, and 12 brass, lead or copper foundries accounted for 1,656, or 55 percent of all reports. Construction, radiator repair, pottery and ceramics manufacturing, and gun firing ranges accounted for the remainder. Reports of construction workers in demolition and paint stripping represented 0.7 percent (23 of 3,077) of all reports, with 15 percent (15 of 100) of reports exceeding 2.90 μmol/L.

TABLE 1—Distribution of Blood Lead Reports at or Above 1.21 μmol/L, April–December 1987

Blood Lead Level	Total Reports[a]		Individuals at Peak Lead Level[b]	
μmol/L[c]	No.	%	No.	%
1.21–1.44	717	27	275	24
1.45–1.92	1277	48	506	45
1.93–2.41	451	17	231	20
2.42–2.89	98	4	68	6
2.90–3.37	52	2	26	2
3.38–3.86	24	.9	14	1
3.87–4.34	11	.4	5	.4
4.35–4.82	6	.2	6	.5
4.83–5.30	2	.1	2	.2
5.31+	5	.2	3	.3
Total	2643	100	1138	100

a) 382 reports less than 1.21 μmol/L (25 μg/dl) were received, but not included above.
b) Includes multiple reports on some individuals.
c) 1 μmol/L = 20.7 μg/dl; 10 μg/dl = .483 μmol/L.

TABLE 2—Demographic Characteristics of Individuals with a Blood Lead Report, April–December 1987

Item	No.	Percent
Age (years)[a]		
16–19	8	1
20–29	134	21
30–39	203	32
40–49	136	21
50–59	114	18
60+	45	7
Sex[b]		
Male	1059	94
Female	71	6
Surname[c]		
Non-Hispanic	687	56
Hispanic	547	44
County of Residence[d]		
Los Angeles	1092	81
Other	258	19

a) Excludes 653 reports not stating age.
b) Excludes 162 individuals for whom gender was not stated or determined.
c) Excludes 37 individuals for whom surname was not classified.
d) Excludes missing data (1457 reports) and 27 out-of-state reports.

Follow-up of Persons with Elevated Blood Lead Levels

Of the 57 persons with blood lead levels exceeding 2.90 μmol/L, 33 (58 percent) were traced and completed telephone interviews; all persons reported occupational lead exposures. Sixteen reported that their blood lead test was part of an employer-sponsored medical monitoring program; 13 were symptomatic workers who sought medical care from a private physician. At least 10 persons had been hospitalized for treatment, including chelation. Many workers expressed deep reservations and fear of job discrimination when CDHS interviewers proposed pursuing follow-up activities with the employer (even without disclosing the name of the case).

Some individuals apparently covered by the OSHA lead standard had not been removed from their job, and some individuals who had been removed were working at other jobs within the same company at a lower pay rate in apparent violation of the OSHA lead standard. One worker alleged that employers colluded to prevent him from obtaining employment because of a history of elevated blood lead.

Because of worker concerns over potential employment discrimination, the protocol was modified and employer contact was generally limited to emergencies involving reports of blood lead exceeding 3.87 μmol/L. At levels between 2.90 and 3.87 μmol/L, follow-up with the employer was pursued if an employee did not express reservations about contact with the employer, or other workers at the worksite with elevated blood lead levels did not object to contact with the employer.

A number of physicians apparently charged with carrying out employer medical monitoring programs were unfa-

TABLE 3—Distribution of Blood Lead Reports by Industry, April–December 1987*

SIC Code	Industry	Reports** N	Reports** %	Individuals N	Individuals %	Facilities N
3341	Secondary lead smelting	1126	37	127	10	3
3691	Battery manufacturing	496	16	246	19	11
3362	Brass foundry	130	4	107	8	12
3721	Aircraft manufacturing	40	1	30	2	1
3269	Pottery products	38	1	20	2	2
9221	Firing range (police)	27	.9	13	1	6
1795	Construction, demolition	17	.6	5	.4	4
7539	Radiator repair	15	.5	8	.6	6
3674	Semi-conductors	9	.3	8	.6	1
7997	Firing ranges (sport)	8	.3	7	.5	4
2782	Printing	7	.2	5	.4	1
1721	Painting contractors	6	.2	3	.2	1
3079	Miscellaneous plastics	6	.2	5	.4	1
4811	Telephone communications	6	.2	4	.3	1
1000	Mining	5	.2	3	.2	2
3351	Copper manufacturing	5	.2	3	.2	1
3699	Electrical machinery	5	.2	5	.4	1
3714	Vehicle parts	5	.2	2	.2	2
——	Missing†	1109	36	677	52	

*Coding of the Standard Industrial Classification (SIC, 1972 Rev.) was based on matching the employer name on the lead report form to those listed in the 1987 California Manufacturer's Directory.

**Less than five reports were received in each of the SICs: inorganic pigment (2816), printing ink (2893), non-ferrous wire (3357), non-ferrous foundry (3360), fabricated metals (3499), special tool manufacturing (3544), local transportation (4111), ship manufacturing and repair (3731), and assay laboratories (7397). Table includes all reports received, including some reports below 1.21 μmol/L.

†Missing data: SIC could not be assigned either because employer identifiers were missing on report, or did not match to entries in the California Manufacturer's Directory (1987).

miliar with the OSHA lead standard. A few physicians were totally unfamiliar with normal limits of blood lead in adults.

Discussion

Before implications of these data can be discussed and conclusions drawn, limitations and potential biases of the data will be discussed. The most important potential bias is the undercounting of lead-exposed individuals with elevated blood lead levels who do not have their blood tested periodically for lead. This prevents the full estimation of the prevalence of elevated blood lead among California adults. Undercounting that differentially affects subgroups also can introduce distortions.

Certain geographic areas and certain industries were probably underrepresented. For example, data from the California Employment Development Department (CEDD) indicated that there were approximately 14,500 employees in 2,790 radiator repair establishments in 1985. However, only three employers, accounting for 15 reports were found in the lead registry in 1987. Similarly, in lead battery manufacturing, where there also is a high probability of direct lead exposure, 11 employers accounting for 496 reports were found in the lead registry, although CEDD data indicated that there were 33 employers with 2,500 workers in June 1985.

The lack of employer-based medical monitoring programs for lead-exposed workers appears to be a significant problem. A recent survey based on a probability sample of California employers indicated that only 2 percent of workers with direct exposures to lead were enrolled in an employer-sponsored, medical monitoring program.[7] Some industries, such as construction, are exempted from the lead standard and medical monitoring requirements.

Underreporting may also result when an out-of-state laboratory analyzed the blood lead of California workers, or an in-state laboratory failed to report. While some out-of-state laboratories did report on a voluntary basis, out-of-state laboratories appear to analyze 47 percent of blood tests of California employers.[7] Since virtually all California laboratories performing lead tests were contacted by CDHS, and failure to report can result in a fine, it is probable that few, if any, California laboratories did not report.

Lack of complete information on basic demographic data such as age, residence, and occupation occurred in a significant proportion of reports. This limits an accurate profile of subgroups where risk may be concentrated and surveillance needs to be expanded.

The timeliness of reporting is another concern for timely case follow-up, particularly for persons with highly elevated blood lead levels. On average, reports were received by CDHS 22 days after blood lead specimens were analyzed by the laboratory. Only 9 percent of report forms were received by CDHS within 72 hours of analysis as required by the reporting requirement. While emergency response was not initially anticipated, follow-up of highly elevated lead cases revealed situations in which imminent hazards had not been abated, and recommendations had or might have had a positive impact.

These data from California's newly implemented blood lead surveillance program indicate the need for intensified lead poisoning surveillance, education, and enforcement in California. Workers, employers, physicians and other health care personnel, laboratories, and government agencies would benefit from expanded training and education focused on lead-related health problems.

The wider implications of this finding is that without an immediate and concentrated effort to reduce occupational lead exposures, it is unlikely that the Public Health Service goal[8] of eliminating lead poisoning by 1990 will be met in California. These data also indicate that current regulations for construction workers exposed to lead do not prevent lead poisoning, and revisions need to be seriously considered. Further, these data indicate the need for occupational health and safety agencies to more vigorously and expeditiously enforce the lead standard.

ACKNOWLEDGMENTS

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Johnson Foundation Announces $3 Million R&D Program to Improve Patient Care

An increasing amount of complex patient care in the United States is being delivered in nursing homes, in ambulatory care clinics, and at home. Yet, the tools and techniques needed to assure that patients receive high quality care in these settings have not yet been fully developed. In an effort to improve services for long-term and ambulatory care patients, the Robert Wood Johnson Foundation of Princeton, NJ, will make available up to $3 million to stimulate and support research and demonstration projects that will identify new and practical mechanisms to assure the delivery of high quality patient care.

The types of projects that will be considered for funding under the foundation's three-year initiative are: research and development of tools that assess the quality of patient care and identify patient care problems and exemplary practices: demonstrations of new approaches to improving quality of care; and evaluations of policies and of systems designed to improve quality of care.

Projects considered for funding may: develop new ways to identify problems in the quality of patient care in specific settings; test existing tools; design and demonstrate institution-wide systems to locate and solve patient care problems; or evaluate existing improvement systems or policies. Projects involving clinical interventions, treatment or drug therapies will *not* be considered under this initiative.

Institutions wishing to apply for funds are asked to submit five copies of a letter of intent of no more than four double-spaced pages, addressed to: Phyllis Kane, Program Assistant, Robert Wood Johnson Foundation, P.O. Box 2316, Route 1 and College Road East, Princeton, NJ, 08543-2316. Based on a review of the letter, the foundation may request a full proposal at a later date.

Technical assistance for the program will be provided by Jack D. McCue, MD, of Baystate Medical Center in Springfield, Mass., and Andrew Kramer, MD, of the University of Colorado Health Sciences Center in Denver.

Recent Time Trends in Uterine Cancer

Victoria Persky, MD, Faith Davis, PhD, Richard Barrett, PhD, Elizabeth Ruby, MS,
Carole Sailer, BA, and Paul Levy, ScD

Abstract: Recent trends in corpus uterine cancer incidence rates were explored using 1979–86 data from the Surveillance and End Results Program (SEER); recent trends in hospitalizations for corpus uterine cancer were explored using 1979–86 data from National Hospital Discharge Surveys (NHDS); and recent trends in exogenous hormone use were delineated using data from the 1980, 1981, and 1985 National Ambulatory Medical Care Surveys (NAMCS). Uterine cancer incidence rates using SEER data have continued to decline since 1979. An acceleration in the decline since 1983–84 is suggested in all women and in women with intact uteri ages 45–64. Hospitalizations for uterine cancer have also declined since 1979, with a marked acceleration in the decline since 1983–84 for all women and for women ages 40–79 has increased 22 percent and use of unopposed exogenous estrogens in women of similar age has increased 7 percent, while use of exogenous progesterones have shown much more substantial increases of approximately 700 percent. Possible relationships between trends in exogenous hormone use and incidence rates of corpus uterine cancer are discussed. (*Am J Public Health* 1990;80:935–939.)

Introduction

Incidence rates of cancer of the corpus uterus showed striking increases in the early 1970s following increases in use of postmenopausal estrogens.[1-3] Subsequently, incidence rates of corpus uterine cancer declined in the late 1970s following declines in use of estrogens.[1] Since 1980, there has been an increase in use of progestins cycled with estrogens in an effort to combat the carcinogenic effect of unopposed estrogens while allowing for a protective effect of estrogens on osteoporosis.[4] The effect of exogenous progesterones on trends in uterine cancer, however, has not been documented. The purpose of the current paper is to delineate more recent time trends in corpus uterine cancer incidence and hospitalization rates in the 1980s in relation to the increasing use of exogenous progestins.

Methods

Age-specific and age-adjusted cancer incidence rates were obtained for the years 1979 through 1986 from the Surveillance Epidemiology and End Results (SEER) Program of the National Cancer Institute. The SEER Program identifies newly diagnosed cancer cases at 11 locations, including nine in the mainland United States plus Hawaii and Puerto Rico. These data, collected since 1973–75, cover approximately 10 percent of the total population of the United States and are considered fairly representative of the US population with respect to age, although Blacks and rural populations are underrepresented. Details of the SEER data collection have been published elsewhere.[5] In the current report, corpus uterine cancer includes ICD-O topography codes 180.0-182.8.[6]

Corpus uterine cancer hospitalization rates between 1979 and 1986 were obtained from the National Hospital Discharge Surveys (NHDS) of the National Center for Health Statistics.[7] Although hospitalization rates are not an exact measure of incidence rates, analyses of trends in the NHDS are presented as a second source of data which, in part, reflect trends in cancer incidence. The NHDS encompasses a representative sample of patients discharged from short stay hospitals, exclusive of federal hospitals, in the 50 states and the District of Columbia. No distinction in NHDS is made between initial admissions and readmissions for corpus uterine cancer. Population estimates are determined by multiplying individual data by sampling weights. In the current report, corpus uterine cancer includes ICD-9 CM code 182.0–182.8.[8]

Hormone use was determined from the National Ambulatory Medical Care Survey (NAMCS) conducted in 1980, 1981, and 1985 with a multistage probability sample of patient visits to office-based physicians in the United States. Physicians were asked to record up to five drugs prescribed at the visit for a random sample of office visits occurring during a randomly selected week during the year.[9,10] Physicians were asked to include both prescription and non-prescription drugs. All medicines containing either estrogens or progesterones were enumerated by year. Birth control pills were not included in these analyses. Medications containing both estrogen and testosterone, however, were included. In 1980, 1981 and 1985, they accounted for an estimated 3.2 percent, 1.0 percent, and 0 percent, respectively, of all estrogens prescribed by physicians for women ages 40–79 in those years. Population estimates were determined by multiplying individual data by sampling weights.

Information on age-specific populations at risk was abstracted from census data.[11] Cancer rates from SEER and NHDS were then calculated by dividing the age-specific estimated numbers by the age-specific populations. In addition, the populations at risk (i.e., women with intact uteri) were establishing by estimating the cumulative age-specific proportions of women who had hysterectomies from hospital discharge data and excluding them from the denominator.[12] Cohort interpolation techniques were used to estimate the proportion of women with intact uteri at single years of age between 1979 and 1986; these figures were then combined to produce five-year rates. Age-adjusted uterine cancer rates from SEER were calculated both by standardization to the 1970 population with uterine cancer not otherwise specified (NOS) included in the data for purposes of comparability to other SEER publications, and by direct standardization to the 1980 population ages 40–79 without NOS included for purposes of comparability with NHDS data. Age-adjusted hospital admissions for uterine cancer rates from NHDS were

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calculated for ages 40–79 by direct standardization to the 1980 population. Age-specific and age-standardized rates were averaged over two-year intervals, to increase the stability of the estimates.

For the NAMCS and NHDS data, standard errors of the age-specific rates were obtained by use of charts, tables, or formulas developed by the National Center for Health Statistics for these surveys. By appropriate algebraic manipulation of these age-specific standard errors, 95 percent confidence intervals were obtained for differences between successive two-year averages of the age-adjusted rates. For the SEER data, the variance among the eight age-adjusted single year rates was computed and this estimated variance was used to obtain 95 percent confidence intervals for differences between successive two-year averages of age-adjusted rates. Also, for the SEER data, linear regression methods were used to estimate the magnitude and statistical significance of the linear component of the time trend in the age-adjusted incidence rates.

Results

For the SEER data, there was a consistent decline each year in the age-adjusted incidence rate from 1979 through 1986 ($p \leq 0.0001$). The average yearly decline in these rates from 1983 to 1986 ($0.77/10^5$) was higher than the decline from 1979 to 1982 ($0.43/10^5$). However, the differences between the two average declines was not statistically significant. As seen in Table 1, age-adjusted uterine cancer incidence rates in SEER declined approximately 1 percent per year between 1979–80 and 1983–84 and 2–3 percent per year between 1983–84 and 1985–86 for all women and for women with intact uteri. Confidence intervals for the declines in age-adjusted rates, however, for each time period included zero. Most of the decrease in uterine cancer rates occurred in the age groups 45–64, with 14–27 percent declines at those ages and with no particular trends apparent in the older and younger age groups (Figure 1).

As seen in Table 2, admissions for uterine cancer in the NHDS declined approximately 1–2 percent per year between the years 1979–80 and 1983–84 and 6 percent per year between 1983–84 and 1985–86. Confidence intervals for the declines in rates between 1983–84 and 1985–86, but not from 1979–80 to 1983–84, excluded zero. Overall trends were similar among different age groups (Figure 2).

As shown in Table 3, between 1980 and 1985 the total number of prescriptions for estrogens increased 22 percent from 11.3 to 13.8 per 100 persons ages 40–79. When women receiving both estrogen and progesterone were subtracted from the estimate, the prescriptions for unopposed estrogen use increased only 7 percent. Confidence intervals for both these increases included zero. During the same time period, however, total progesterone prescriptions increased from 0.6 to 4.9 per 100 persons (694%) and prescriptions for both estrogens and progesterones increased from 0.2 to 1.9 per 100 persons age 40–79 (946%). Confidence intervals for the increases in progesterone use excluded zero.

Discussion

The overall decline in uterine cancer rates since the mid-1970s[1–3] has been attributed primarily to a decrease in the use of unopposed estrogens. This paper documents the continuation of this trend from two different data sources and also suggests that since 1983–84 there may have been an acceleration in this decline in uterine cancer concomitant with little change, or even a slight increase, in unopposed estrogen use. Data from SEER, but not NHDS, suggest that the declines in uterine cancer rates may be localized to age groups between 45–64 years. Exogenous hormones are

TABLE 1—Age-Specific and Age-Adjusted Corpus Uterine Cancer Incidence Rates[a] per 100,000 US Women, 1979–86, for All Women and for Women with Intact Uteri, Surveillance Epidemiology and End Results (SEER)

	All Women				Women with Intact Uteri			
Age (years)	1979–80	1981–82	1983–84	1985–86	1979–80	1981–82	1983–84	1985–86
25–29	0.7	0.9	0.7	0.8	0.7	1.0	0.7	0.8
30–34	2.3	2.8	2.6	2.1	2.5	3.0	2.8	2.3
35–39	5.5	6.7	4.8	6.0	6.4	7.8	5.6	7.0
40–44	12.2	12.1	11.4	13.1	15.6	15.6	14.6	16.9
45–49	26.6	25.8	24.3	21.9	36.7	35.8	34.5	31.6
50–54	55.1	46.1	41.0	41.6	82.7	69.2	61.3	63.1
55–59	79.4	71.4	65.2	60.0	119.2	109.8	102.1	95.2
60–64	118.3	110.3	104.6	85.9	173.3	164.1	160.5	135.5
65–69	110.1	111.9	117.5	110.7	168.0	169.8	177.5	168.7
70–74	100.9	108.8	112.4	111.5	160.0	171.9	177.0	175.1
75–79	86.8	94.9	97.4	92.6	143.9	156.0	159.3	151.0
Age-Adj[b]	70.2	68.0	66.5	62.0	102.6	100.0	98.5	92.7
Decline[c]		−2.2	−1.6	−4.5		−2.6	−1.5	−5.8
(95% CI)[d]		(−8.7,4.5)	(−8.2,5.0)	(−11.1,2.1)		(−10.7,5.5)	(−9.6,6.5)	(−13.9,2.3)
% Decline[e]		−3.1	−2.2	−6.8		−2.5	−1.5	−5.9
Age-Adj[f]	24.5	23.8	23.1	21.6				
Decline[c]		−0.7	−0.7	−1.5				
(95% CI)[d]		(−3.1,1.7)	(−3.2,1.7)	(−3.9,0.9)				
% Decline[e]		−2.9	−2.9	−6.5				

a) Rates were averaged for the years 1979–80, 1981–82, 1983–84, and 1985–86.
b) Age-adjusted for the ages 40–79 by the direct method to the 1980 population of women ages 40–79.
c) Absolute decline in age-adjusted rates.
d) 95% confidence limits for the decline in age-adjusted rates.
e) Percentage decline in age-adjusted rates.
f) Age-adjusted for all ages by the direct method to the 1970 population.

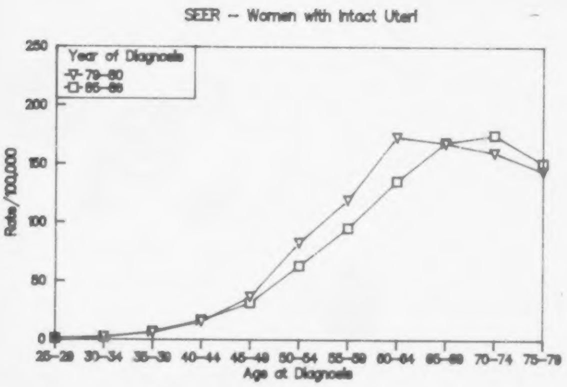

FIGURE 1—Age-Specific Uterine Cancer Incidence Rates by Year of Diagnosis: SEER—Women with Intact Uteri

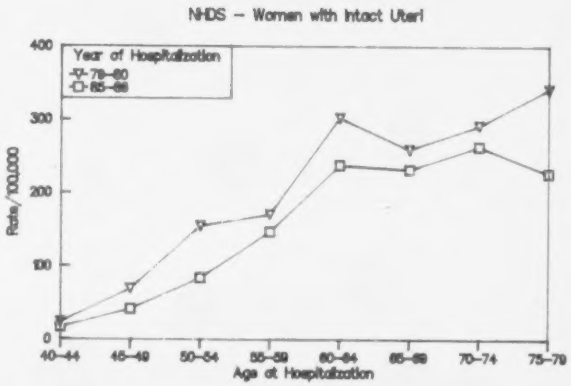

FIGURE 2—Age-Specific Uterine Cancer Hospitalization Rates by Year of Hospitalization: NHDS—Women with Intact Uteri

thought to act at the promotional stage of uterine corpus carcinogenesis and to act within a short period of time: in the 1970s, trends in cancer rates followed trends in hormone use by only a few years[1] and case-control studies[13] estimate latent periods of only three to six years. Thus it is possible that the decline since 1979 partly reflects a very recent increase in use of postmenopausal progestins. A protective effect of progestins is consistent with lower risks of uterine cancer observed in women on birth control pills containing both estrogens and progesterones,[14-16] and with two recent studies in which post-menopausal women using estrogen-progesterone combinations were at somewhat lower risk of uterine cancer (OR = 0.6, CI = 0.2–1.4) and (OR = 0.9, CI = 0.4–2.0) than women not using hormones.[17-18] Previous studies have also noted that adenomatous hyperplasia, thought to be a precursor to endometrial cancer, is reversed by the addition of progesterone.[19] Similarly, estrogen receptor activity is increased by estrogens and decreased by progesterones, lending biologic plausibility to a protective action of progesterone on estrogen-induced cancer.[20]

Another possible explanation for the declines in uterine cancer rates since 1979 is a protective effect of birth control pills on cancer development, manifesting itself 10–20 years after exposure to contraceptives. Women currently ages 45–64 were ages 20–40 when oral contraceptives were first introduced. Older women were never exposed to oral contraceptives and were unlikely to have been exposed to postmenopausal progestins, which have been used only since 1970 and are used infrequently for women over age 65 years. In the current study, only 3–5 percent of progestins being prescribed for women in the years 1980, 1981, and 1985 were prescribed for women over 65 years of age.

Hospital discharge data cannot accurately measure uterine cancer incidence rates because hospitalizations, rather than people, are enumerated, and the same person hospitalized repeatedly for the same illness may be counted more than once. Rates of hospitalization for cancer in NHDS are higher than cancer incidence rates in SEER.[21] In the current study we found that hospitalization rates for uterine cancer based on NHDS were approximately twice the incidence rates for uterine cancer in SEER. Although much of the acceleration in the declines in hospitalizations seen since 1983–84 might be attributed to overall changes in hospitalizations secondary to the introduction of DRGs (diagnosis-

TABLE 2—Age-Specific and Age-Adjusted Hospital Admission Rates[a] For Uterine Cancer (per 100,000) US Women, 1979–86, for all Women and for Women with Intact Uteri, National Hospital Discharge Survey (NHDS)

	All Women				Women with Intact Uteri			
Age (years)	1979–80	1981–82	1983–84	1985–86	1979–80	1981–82	1983–84	1985–86
40–44	18.5	24.7	13.2	12.8	23.6	31.8	16.8	16.5
45–49	50.0	28.7	37.5	28.8	69.0	39.9	53.1	41.5
50–54	102.9	67.1	61.8	55.1	154.6	100.6	92.4	83.8
55–59	113.3	117.5	112.4	92.5	170.3	180.6	176.1	146.8
60–64	206.7	209.9	183.9	151.1	302.8	320.1	282.0	237.9
65–69	170.3	229.4	215.7	152.2	259.7	347.9	325.6	232.0
70–74	184.6	216.0	184.8	168.0	292.0	340.9	290.8	263.6
75–79	206.5	156.0	171.7	139.4	342.2	256.3	280.3	226.9
Age-adj[b]	122.0	122.5	113.1	92.1	178.4	179.9	167.5	138.0
Decline[c]	−8.8		−21.0		−10.8		−29.6	
(95% CI)[d]	(−22.6,5.0)		(−30.4,−1.2)		(−31.9,10.3)		(−44.1,−1.5)	
% Decline[e]	−7.3		−18.6		−6.1		−17.6	

a) Rates were averaged for the years 1979–80, 1981–82, 1983–84, and 1985–86.
b) Age-adjusted by the direct method to the 1980 population of US women ages 40–79
c) The decline in averaged age-adjusted rates were calculated for the time periods 1979–80 to 1983–84 and 1983–84 to 1985–86.
d) 95% confidence intervals for the decline in averaged age-adjusted rates.
e) The percentage decline in averaged age-adjusted rates were calculated for the time periods 1979–80 to 1983–84 and 1983–84 to 1985–86.

TABLE 3—Age-Adjusted Exogenous Hormones Use per 100 Persons by Year for Ages 40–79, Adjusted to 1980 Age Distribution, National Ambulatory Medical Care Survey (NAMCS)

Hormone	Years			Change 1980–85 (95% CI)[a]	Percent Change 1980–85
	1980	1981	1985		
All Estrogen	11.29	11.23	13.81	2.52 (−1.48,6.51)	+22%
Unopposed Estrogens	11.11	10.91	11.86	0.78 (−3.06,4.61)	+7%
Estrogens and Progesterones	0.18	0.32	1.92	1.74 (0.78,2.70)	+946%
All Progesterones	0.61	1.25	4.87	4.26 (2.96,5.55)	+694%

[a] 95% confidence intervals for change in rate 1980–85.

related groups) preferentially affecting the elderly, the accelerations in the overall declines in incidence rates for corpus uterine cancer in SEER suggest that there may have been alterations in trends in incidence rates as well.

The use of physician office visit prescriptions to estimate hormone use is subject to several potential errors. Although total use of progesterone can be approximated, use of progesterone simultaneously with estrogen cannot be precisely measured, since the NAMCS measures prescriptions at an individual visit, rather than total prescriptions. In addition, although every effort was made to eliminate birth control pills from the analysis, it is possible that some of the younger women may have been using birth control pills, rather than estrogen and progesterone, as noted. The restriction of the analyses to women ages 40–79 should minimize this error.

The number of drug prescriptions may well be underestimated, since physicians were limited to a total of five drugs prescribed at each visit. A recent study using data from the National Disease and Therapeutic Index (NDTI) reported between 15 and 43 total oral estrogen mentions per 100 women ages 45–64 in 1985.[4] They also noted a substantial increase in the percent of women prescribed both estrogens and progesterone. Use of both hormones account for 4 percent of all estrogen mentions in 1979 as compared to 28 percent in 1986. Unlike the NAMCS in the current study, the NDTI includes outpatient clinics, prescriptions written in hospitals, and telephone prescriptions. Since ascertainment of drug use in the NHDS, however, was similar in each year of the study, systematic underestimates of exogenous hormone use should not affect time trends.

A detailed breakdown of specific estrogens used also revealed that a small percentage of women in 1980 and 1981 ingested hormones containing both estrogens and testosterone. A total of 3.2 percent of women using estrogens in 1980, 1.0 percent of women using estrogens in 1981, and 0 percent using estrogens in 1985 used medication also containing testosterone. These results are consistent with those of Hemminki, *et al*,[4] who also noted that injected androgen/estrogen preparations decreased from 7 percent in 1974 to 3 percent in 1986. We were not able to find any previous human studies which examined the effect of exogenous testosterone on endometrial hyperplasia. Studies in rabbits[22] and in endometrial adenocarcinoma in vitro cell lines,[23] however, indicate that testosterone has no effect on the development of hyperplasia or on tumor cell growth. Since only a small number of women in 1980 and 1981 were using testosterone, they were retained in the analysis. Finally, the numbers of women using progesterone in specific age strata were small, precluding reports of age-specific rates. Despite the problems in estimating estrogen and progesterone use, consistency with other data and the magnitude of the increase between 1980 and 1985 support the possibility that the increase in use of progestins may be contributing to an acceleration in the decline in uterine cancer since 1984.

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Cancer Mortality in Native Americans in North Carolina

Ronnie D. Horner, PhD

Abstract: This paper describes age-adjusted mortality from malignant neoplasms for Native Americans in North Carolina for 1968–72 and 1978–82. Sex-specific standardized mortality ratios were calculated from death certificate data, using the cancer mortality experience of White North Carolinians to obtain the number of expected deaths. For most categories and specific sites of cancer, mortality was at or below the expected level, but higher than expected mortality was found for genitourinary cancers in males (SMR = 1.62, 95% CI = 1.15, 2.21) for the 1978–82 period; within this category, there was a higher than expected level of mortality from prostate cancer (SMR = 2.00; 95% CI = 1.36, 2.83) and cancer of the penis and other male genital organs (SMR = 9.09; 95% CI = 1.10, 32.84). Female Native Americans had an elevated mortality from cervical cancer (SMR = 2.27, 95% CI = 1.09, 4.17) for the 1968–72 period only. (*Am J Public Health* 1990; 80:940–944.)

Introduction

The epidemiology of cancer in Native American tribes in the eastern United States is not well described. Studies of the Seneca Nation in New York State found lower than expected mortality from cancers of all sites for males and females of this tribe.[1,2] In comparison to White residents of New York State (exclusive of New York City), Seneca women had lower mortality from cancers of the pancreas and breast, but higher mortality from cervical cancer; Seneca men had site-specific cancer mortality at or below the expected level.[1]

Native Americans nationally and in the Southwest show a lower than expected overall cancer mortality and incidence.[3,4] Alaskan Native Americans experience a level of mortality and incidence from all cancers which is similar to White Americans.[5–9] For specific sites, elevated mortality (and incidence) is found for cancer of the gallbladder (particularly for females),[3,7,10–13] esophagus and nasopharynx (for Alaskan Native Americans),[5,6,8,14,15] stomach,[16,17] cervix,[3,5,8,18,19] and multiple myeloma (in males).[20] Significantly lower mortality (and incidence) is found for lung cancer,[3,5,7,16,21] cancer of the female breast,[3,6,7,8,16] melanomas,[3,6] lymphomas and leukemias,[20] pancreatic cancer,[3,16] colon cancer,[3] and cancer of the prostate gland (particularly for Eskimos and Aleuts).[3,5–8] Alaskan Native Americans have an increasing incidence of lung cancer for both sexes; for females, esophageal and cervical cancers are decreasing.[6,7,9]

This report describes cancer mortality in Native Americans in North Carolina for the 1968–72 and 1978–82 periods, to gain insights into possible changes over time.

Methods

Native Americans in North Carolina are from several tribes, including the Cherokee, Coharie, Eno-Occan-Eechee, Haliwa-Saponi, Lumbee, Meherrin, Tuscardra, and Waccamaw-Sioun. The Cherokee in western North Carolina and the Lumbee in the eastern region of the State are the largest tribes. There has been considerable interbreeding between Native Americans, Whites and, to a lesser extent, Blacks in the region.[22–25] As a consequence, there are few "full-blooded" Native Americans in any of the tribes in the State. Moreover, cancer mortality data by tribe are not available.

Population data for this study came from the 1970 and 1980 US census reports for North Carolina.[26,27] Sixteen age categories were used: <5 years old, 5–9, 10–14, . . ., 70–74, and 75+ years of age. The distribution of Native Americans by sex but not age was available for 1970, so the sex-specific age distributions of Native Americans for 1980 were used to estimate the 1970 age distributions.

Cancer mortality data were obtained from the detailed mortality data tapes of the North Carolina State Center for Health Statistics using the underlying cause of death for North Carolina residents. Probably some Native Americans were classified as White. (The magnitude of the racial misclassification bias is currently under investigation: Personal communication from Dr. Tim E. Aldrich, director of the Central Cancer Registry of North Carolina.)

The mortality data were classified according to the broad categories of malignant neoplasms found in the International Classification of Diseases (ICD) and by specific sites within these categories.

The use of broad categories was necessary because the data for specific cancer sites for Native Americans in North Carolina were sparse. The use of broad categories also reduced the effect of changes in the classification of cancers; ICD-8 and ICD-9, though, are essentially identical for malignant neoplasms at the three-digit code level.

Specific sites identified by previous studies as being above or below the expected level were also given attention.

The standardized mortality ratio (SMR) was calculated using the 1980 age- and sex-specific cancer mortality rates of White residents to obtain the expected number of deaths. Although SMRs between different areas (times) usually should not be compared because of different standards, the identical age distribution in the Native American population in 1970 and 1980 (for the reason described) and the use of the same set of rates permit comparisons between time periods.[28] In essence, the only difference between the 1970 and 1980 SMRs are the cancer mortality rates for Native Americans which are reflected in the observed number of deaths. Cancer deaths were assumed to follow a Poisson distribution. The 95% confidence intervals for the sex-specific SMRs were calculated according to the approach described by Kahn and Sempos.[29]

Results

The proportion of observed cancer deaths by category among Native American and White residents of North Carolina in 1968–72 and 1978–82 is shown in Table 1. For

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TABLE 1—Percentage Distribution of Deaths from Malignant Neoplasms, Native Americans and White Residents of North Carolina, 1968–72 and 1978–82, by Sex and Category*

Category of Malignancy (ICD Code)	Native Americans		Whites	
	1968–72	1978–82	1968–72	1978–82
Males	(n = 76)	(n = 150)	(n = 13,747)	(n = 20,317)
Lip, Oral Cavity, and Pharynx (140–149)	1.3	2.7	3.3	2.3
Digestive Organs and Peritoneum (150–159)	27.6	19.3	22.5	21.5
Respiratory and Intrathoracic Organs (160–165)	19.7	30.0	32.8	38.2
Bone, Connective Tissue, Skin, and Breast (170–175)	1.3	0.7	3.7	3.2
Genitourinary Organs (179–189)	23.7	26.0	14.8	14.4
Lymphatic and Hematopoietic Tissue (200–208)	14.5	11.3	11.1	9.2
Other and Unspecified Sites (190–199)	11.8	10.0	11.8	11.3
Females	(n = 44)	(n = 89)	(n = 11,268)	(n = 16,285)
Lip, Oral Cavity, and Pharynx (140–149)	2.3	3.4	2.0	1.6
Digestive Organs and Peritoneum (150–159)	18.2	27.0	25.5	25.2
Respiratory and Intrathoracic Organs (160–165)	2.3	3.4	7.3	13.8
Bone, Connective Tissue, Skin, and Breast (170–175)	18.2	19.1	22.7	22.1
Genitourinary Organs (179–189)	36.4	19.1	18.4	14.7
Lymphatic and Hematopoietic Tissue (200–208)	9.1	13.5	10.8	10.2
Other and Unspecified Sites (190–199)	13.6	14.6	13.2	12.4

*Percentages may not sum to 100% due to rounding.

White residents of both sexes, the proportion of cancer deaths within each category is fairly stable between the two periods. Among male Native Americans, deaths from cancer of the digestive organs and peritoneum decreased, but deaths from cancers of the respiratory and intrathoracic organs increased. For female Native Americans, deaths from cancers of the digestive organs and the peritoneum increased, but genitourinary cancer deaths decreased. None of the differences between time periods were statistically significant.

As Table 2 shows, Native Americans experienced a generally lower or equal level of mortality from the various cancers to that expected based on the experience of White North Carolinians. The only clearly elevated SMR is for genitourinary neoplasms in male Native Americans for the 1978–82 period (SMR = 1.62, 95% CI = 1.15, 2.21); the SMR for this category is also elevated for 1968–72.

The SMRs in Table 2 suggest that changes in cancer mortality for Native Americans may have occurred between 1968–72 and 1978–82. There is an increase in the number of cancer deaths for Native American females from significantly below to near the expected levels for digestive organ and peritoneum cancers. A similar change occurs for respiratory and intrathoracic cancer mortality for male Native Americans. Also as noted previously, deaths from genitourinary cancers increased from a level similar to the expected number to a higher number for male Native Americans. Both sexes may also be experiencing an increase in cancers of the lip, oral cavity, and pharynx.

Table 3 shows the SMRs associated with specific cancer sites which have been identified as having significantly above or below expected mortality for Native Americans. The SMRs for each three-digit site are available on request to the author. Most deaths from cancer at the various anatomic sites are at levels similar to that found among White residents of North Carolina. Deaths from cancer of the breast and colon are lower than expected in both time periods for females. Mortality from cancer of the cervix uteri was more than twice that of Whites in 1968–72 and in 1978–82. A slight increase in mortality from prostatic cancer is indicated; and rates are elevated in both periods. Mortality from cancer of the penis and other male genital organs (ICD 187) is also significantly elevated in both periods.

Discussion

The Native Americans in this report represent several tribes which have bred extensively with other racial groups, and yet their cancer mortality experience generally follows that of Native Americans elsewhere in the nation, with lower than expected mortality from cancers of all sites, respiratory and intrathoracic cancers, and cancers of the female breast, but a higher than expected mortality for cancer of the cervix uteri. The higher mortality from prostate cancer seen in this study was also found for Alaskan Indians.[3,5,6,8] A unique finding of this study is the elevated mortality from cancer of the penis and other male genital organs (ICD 187). Unlike Alaskan Native Americans, no nasopharynx cancers were reported in either study period. Nor was there a higher than expected mortality from cancers of the gallbladder and stomach which are common in tribes of the Southwest.

Clearly elevated mortality in North Carolinian Native Americans was found only for cancers of the prostate, male

TABLE 2—Standardized Mortality Ratios (95% CI) for Malignant Neoplasms, Native American Residents of North Carolina, 1968–72 and 1978–82, by Sex and Category

	Males		Females	
Category of Malignancy (ICD Code)	1968–72 (95% CI)	1978–82 (95% CI)	1968–72 (95% CI)	1978–82 (95% CI)
All Sites (140–208)	0.79 (0.62, 0.99)	0.87 (0.73, 1.02)	0.54 (0.39, 0.73)	0.71 (0.57, 0.87)
Lip, Oral Cavity and Pharynx (140–149)	0.32 (0.01, 1.80)	1.02 (0.28, 2.61)	0.64 (0.02, 3.57)	1.61 (0.33, 4.71)
Digestive Organs and Peritoneum (150–159)	1.02 (0.63, 1.57)	0.80 (0.53, 1.14)	0.41 (0.18, 0.82)	0.85 (0.54, 0.96)
Respiratory and Intrathoracic Organs (160–165)	0.48 (0.27, 0.79)	0.70 (0.51, 0.94)	0.17 (0.004, 0.94)	0.17 (0.03, 0.49)
Bone, Connective Tissue, Skin, and Breast (170–175)	0.25 (0.01, 1.38)	0.16 (0.004, 0.90)	0.42 (0.18, 0.82)	0.57 (0.33, 0.91)
Genitourinary Organs (179–189)	1.39 (0.82, 2.20)	1.62 (1.15, 2.21)	1.06 (0.61, 1.72)	0.93 (0.54, 1.46)
Lymphatic and Hematopoietic Tissue (200–208)	0.92 (0.46, 1.64)	0.85 (0.47, 1.40)	0.42 (0.12, 1.09)	0.91 (0.47, 1.59)
Other and Unspecified Sites (190–199)	0.74 (0.34, 1.41)	0.83 (0.48, 1.33)	0.55 (0.20, 1.20)	0.84 (0.44, 1.43)

TABLE 3—Standardized Mortality Ratios (95% CI) for Selected Malignant Neoplasms, Native American Residents of North Carolina, 1968–72 and 1978–82, by Sex

	Males		Females	
Site of Malignancy (ICD Code)	1968–72 (95% CI)	1978–82 (95% CI)	1968–72 (95% CI)	1978–82 (95% CI)
Nasopharynx (147)	0.00 (0.00, 12.30)	0.00 (0.00, 11.53)	0.00 (0.00, 26.34)	0.00 (0.00, 23.06)
Esophagus (150)	0.00 (0.00, 2.20)	0.97 (0.20, 2.83)	1.16 (0.03, 6.48)	3.57 (0.93, 9.14)
Stomach (151)	1.42 (0.46, 3.31)	1.60 (0.64, 3.29)	0.82 (0.10, 2.96)	1.47 (0.40, 3.77)
Colon (153)	0.64 (0.17, 1.63)	0.38 (0.12, 0.86)	0.24 (0.03, 0.87)	0.31 (0.08, 0.79)
Gallbladder (156)	0.00 (0.00, 5.76)	0.00 (0.00, 3.80)	0.84 (0.02, 6.07)	2.42 (0.50, 7.07)
Pancreas (157)	1.93 (0.93, 3.55)	1.00 (0.46, 1.90)	0.52 (0.06, 1.88)	0.95 (0.35, 2.08)
Trachea, Bronchus or Lung (162)	0.44 (0.23, 0.75)	0.71 (0.52, 0.96)	0.18 (0.005, 1.01)	0.17 (0.04, 0.51)
Breast, Female (174)	—	—	0.37 (0.13, 0.77)	0.59 (0.34, 0.99)
Cervix Uteri (180)	—	—	2.27 (1.09, 4.17)	2.30 (0.99, 4.53)
Prostate (185)	1.70 (0.91, 2.91)	2.00 (1.36, 2.83)	—	—
Penis and other male genital organs (187)	22.22 (2.69, 80.27)	9.09 (1.10, 32.84)	—	—
Lymphomas (200–202)	0.46 (0.06, 1.65)	0.30 (0.04, 1.10)	0.28 (0.01, 1.56)	0.84 (0.23, 2.16)
Multiple Myeloma (203)	0.72 (0.02, 4.04)	1.48 (0.40, 3.24)	0.00 (0.00, 3.32)	1.98 (0.54, 5.07)
Leukemias (204–208)	1.28 (0.55, 2.53)	1.07 (0.49, 2.03)	0.56 (0.12, 1.64)	0.63 (0.17, 1.60)

genitalia, and the cervix. Prostatic and penile cancers are more prevalent in Blacks than either Whites or Native Americans generally.[30,31] However, the racial mixing in Native Americans of North Carolina is unlikely to account for their unexpectedly higher mortality from these cancers because the Black contribution to the genetic pool of most tribes of the Carolinas is indicated to be minimal.[22–25] Diet may be involved in cancer of the prostate. Although controversial, there is epidemiologic evidence of a positive association between prostatic cancer and a diet high in fats and vitamin A, particularly in older males.[32–35] However, an inverse association between the level of consumption of green and yellow vegetables (and hence vitamin A) and prostatic cancer is found for Japanese males.[36] Dietary information on North Carolinian Native Americans is not available. The elevated mortality from cervical cancer may indicate a low level of cervical cancer screening among Native American females in North Carolina. An inverse association between extent of cervical cancer screening in populations and mortality from cancer of the cervix is reported for Native Americans elsewhere.[18,19]

There is indication that the cancer mortality experience of North Carolinian Native Americans may be worsening, which would suggest that the lower than expected cancer mortality for Native Americans is more strongly related to environmental factors than to genetics. Although the number of cases is too few for definitive conclusions, an increase in mortality may be occurring from: cancer of the lip, oral cavity, and pharynx for both sexes; cancers of the respiratory and intrathoracic organs, and genitourinary organs for males; and cancers of the digestive organs and peritoneum for females. For specific sites, an increase in mortality may be occurring for cancer of the prostate and the trachea, bronchus, and lung for males. It has been suggested that lung cancer mortality is increasing in Alaskan Native Americans as well.[6,7] Information on the use of tobacco products such as snuff and chewing tobacco by Native Americans in North Carolina is not available, although several reports indicate high prevalence of tobacco use among younger Native Americans elsewhere.[37–40]

It is recognized that the patterns reported in this study may reflect several biases. There is the possibility of racial misclassification bias in the mortality statistics, although its presence and magnitude have yet to be determined. Moreover, the age-specific population data for Native Americans in 1970 are only estimates. Diagnostic bias may also be present; however, the proportion of "other and unspecified" cancers has remained stable over time. The data also reflect coding under the eighth and ninth ICD; however, the two revisions are essentially identical for neoplasia. Perhaps of more concern, the data were aggregated across tribes which could obscure patterns of cancer mortality within tribes.

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HUD Issues Guidelines on Lead-Based Paint Abatement

The US Department of Housing and Urban Development (HUD) has issued the first federal guidelines for the identification and abatement of lead-based paint in all public and Indian housing developments. The interim guidelines, signed by HUD Secretary Jack Kemp and published in the Federal Register, became effective April 1 and apply to all rehabilitation programs in public housing from that date forward. While the guidelines are recommendations and not mandatory, they represent the first national technical rules and procedures for testing, abatement worker protection, clean-up and disposal of lead-based paint in residential structures. The standards outlined in the 160-page document include several procedures for lead paint testing and removal that have proven effective in cities where lead abatement programs are mandated, such as Baltimore and Boston. Lead-based paint is believed to exist in about 40 million homes, or 40 percent of the country's housing stock where lead paint was used prior to 1970.

The federal guidelines recommend three accepted abatement strategies: complete replacement of all lead-painted surfaces, encapsulation or sealing of lead-painted areas, or paint removal. The guidelines outline the various methods of paint stripping, sanding and chemical processing, and the appropriate precautions to be taken with each, including daily and final clean-up. Proper clean-up procedures involve a thorough vacuuming, using a High Efficiency Particulate Air (HEPA)-filtered vacuum, followed by wet wiping with a high-phosphate solution, followed by a second HEPA vacuuming. The guidelines also recommend that sanding flat surfaces should be done with a sander attached to a HEPA vacuum that can collect the dust particles as they are released. Nilfisk of America, Inc., of Malvern, PA, one of the nation's leading manufactures of HEPA-filtered vacuums used in removal of lead, asbestos, silica, fiberglass and other harmful dusts, was asked by the National Institute of Building Sciences to participate in drafting the rules and recommendations that formed the basis for HUD's interim guidelines. For further information, contact HUD Headquarters, 451 7th Street, SW, Washington, DC 20410. Tel: (202) 755-6422.

Defining Arthritis and Measuring Functional Status in Elders: Methodological Issues in the Study of Disease and Physical Disability

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Abstract: This study explores the degree to which the association of knee osteoarthritis with physical disability changes with different definitions of osteoarthritis in 1,416 Framingham Study elders. When all categories of radiographic osteoarthritis were aggregated into a single "arthritis" variable and dependence upon human assistance in one or more functional activities combined into a single variable, elders with osteoarthritis had only moderately increased odds for dependence after controlling for age or sex (OR = 1.25). A definition of osteoarthritis based only upon symptoms produced larger odds for dependency (OR = 1.85). Elders with mild osteoarthritis and infrequent knee pain had no significantly elevated risk for dependence in any of the seven functional activities. Elders with infrequently symptomatic, moderate to marked radiographic osteoarthritis were at increased risk for dependence in stair climbing, walking a mile, housekeeping, and carrying bundles. Elders with radiographic osteoarthritis accompanied by frequent pain had an increased odds of dependence in stair climbing, walking a mile, and housekeeping. Using a generic definition of "arthritis" and aggregating functional activities may underestimate the impact of osteoarthritis on physical disability in the elderly and obscure the task-specific nature of that relationship. (*Am J Public Health* 1990; 80:945–949.)

Introduction

Diseases are often defined broadly in epidemiologic studies of the elderly and ascertained by self-report and clinical proxy measures such as symptoms. Using "arthritis" as a generic term, previous studies have provided broad insights into the relation between "arthritis" and disability.[1-4] These results do not necessarily provide us with information that captures the relation of a particular type and severity of arthritis or arthritic symptoms to functional limitations. Osteoarthritis refers to a specific pathological process within joints which is well-captured by radiographs that can be used to grade disease severity. The presence or absence of joint symptoms creates another dimension of disease definition.

A second issue in the study of disease and disability that requires examination is specification of the functional outcome. Combining several kinds of functional items into a single index for an overall score to estimate prevalence of disability[5-9] may be justified when the disease affects functional activities globally (e.g. the effects of stroke on activities of daily living) or when the summary score aggregates functional tasks of the same biomechanical or sensorimotor type (e.g. hand dexterity). However, a summary score may obscure the impacts of a disease on specific functional activities, particularly if many of the other activities included in the index are relatively unaffected by that disease.

Osteoarthritis is the most common form of arthritis in the elderly, and osteoarthritis of the knee is commonly associated with clinical symptoms and disability.[10] The first purpose of this study is to identify how the association of knee osteoarthritis with physical disability among elders changes using specific radiographic grades of osteoarthritis and the presence of symptoms to define the disease. The second purpose is to use these definitions to explore the association of knee osteoarthritis with discrete limitations in particular functional activities.

Methods

Study Population and Sample

The study population was the Framingham Heart Study cohort, a population-based cohort of the adult residents of Framingham, Massachusetts, designed to investigate factors associated with cardiovascular disease, and examined biennially since 1948. The prevalence of knee osteoarthritis during the 18th biennial examination (1983–85) has been reported elsewhere.[11] There were 1,826 participants in examination 18, of whom 1424 received knee radiographs. Eight persons were excluded from the present study; four with bilateral total knee replacements, another four with rheumatoid arthritis, leaving 1,416 cohort members.

Definitions of OA and Pain

Osteoarthritis (OA) was graded by an academically based bone and joint radiologist using the criteria of Kellgren and Lawrence:[12] grade 0 = normal radiograph; grade 1 = possible osteophytes; grade 2 = definite osteophytes; grade 3 = osteophytes and joint space narrowing; and grade 4 = large osteophytes, marked narrowing of joint space and definite deformity. Most studies have used grade 2 (the presence of definite osteophytes) as the criterion for defining disease, while a few others have required evidence of joint space narrowing (grade 3), corresponding to clinical definitions of disease, to designate osteoarthritis.[10] The radiographic grade for each subject in this study was assigned according to the most severely affected knee. Using the approach of the first National Health and Nutrition Examination Survey,[13] symptoms were defined as pain in or around the knee lasting at least a month within the previous year. Respondents who had either no symptoms or who may have had only infrequent pain were designated as asymptomatic.

We created three different definitions of radiographic osteoarthritis: asymptomatic grade 2 osteoarthritis, asymptomatic $\geq$ grade 3 osteoarthritis, and symptomatic $\geq$ grade 2 osteoarthritis. Subjects with symptoms were classified as those without radiographic evidence of disease and those with $\geq$ grade 2 osteoarthritis.

Measures of Physical Disability

Data were collected on 16 measures of physical disability at examination 18. Six items measuring the most basic activities of daily living were rejected for inclusion as we found little disability on these items, typical in a sample of

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elders living independently in the community. Another three items measuring more complex activities were rejected for similar reasons. Of the seven remaining functional measures, two items covered activities explicitly involving the lower extremities: walking up and down a flight of stairs, and walking a mile; each of these items was adapted from the Rosow-Breslau Functional Health Index,[14] and had been used previously at Framingham. Five measures covered functional tasks requiring both upper and lower extremity use: housekeeping, heavy home chores including shoveling snow and washing windows, cooking, grocery shopping and carrying bundles weighing 10 pounds. The item on heavy home chores came from the Rosow-Breslau Functional Health Index; the last item was taken from an instrument developed by Nagi[15]; the items on housekeeping, cooking, and grocery shopping had been previously used at Framingham.[16]

Items from the Rosow-Breslau were recorded as able or unable to do without help. The items on housekeeping, cooking, and grocery shopping asked whether the respondent could perform that task entirely without help from another person. The item on carrying bundles was part of a physical performance battery administered by a trained nurse. It was scored as independent, dependent upon an assistive device, dependent upon human assistance, or unable to do. In order to make the definition of the dependent variable comparable across items, the need for human assistance was chosen as the criterion of disability on all seven dependent variables.

Data Analysis

We calculated two sets of prevalence odds ratios for dependence in performing each of the seven functional activities using logistic regression analyses, controlling for age as a continuous variable and sex. An odds ratio was defined as the relative odds of functional dependence among subjects with a specific definition of knee osteoarthritis divided by the relative odds of functional dependence among subjects without knee pain or osteoarthritis. The first logistic regression model explored odds for those elders with radiographic osteoarthritis. The second model explored odds for those elders with symptoms or symptoms plus radiographic disease.

Results

The age and sex of the subjects in our sample are described in Table 1. There were 589 men and 827 women in our sample (mean age = 72.7 years). There were 214 subjects with asymptomatic grade 2 osteoarthritis, 151 with asymptomatic osteoarthritis ≥ grade 3, 103 with knee pain and at least grade 2 osteoarthritis, and 57 with knee symptoms but no radiographic evidence of disease; 891 elders without knee pain or radiographic osteoarthritis served as controls. Due to missing data on functional measures, the number of elders in each of these groups is slightly lower in the results reported below.

The results of aggregating all radiographic osteoarthritic categories or using symptom reports as exposure variables while combining dependence in one or more functional activities into a single dependent variable are displayed in Table 2. Based upon these data, 37.5 percent of the subjects with osteoarthritis were dependent in one or more ADL compared to 29.8 percent of their peers without osteoarthritis. Furthermore, elders with osteoarthritis had only modestly increased odds for dependence in one or more functional activities after controlling for age and sex. Using a symptom-based definition of osteoarthritis, without respect to radiographic disease, showed an even larger proportion of disabled elders (46.2 percent). These elders had significantly increased odds for dependency in one or more functional activities. Using specific definitions of osteoarthritis and disaggregating functional measures, however, demonstrated quite different results.

The odds ratios for dependence upon human assistance to perform the two lower extremity activities are shown in Table 3. Overall, the elders in our sample exhibited little dependence in either activity. There were, however, substantially more elders in both the osteoarthritis and nonosteoarthritis groups dependent in walking a mile (14.2 percent) than dependent in stair climbing (3.2 percent). Combining all specifications of osteoarthritis into a single category reveals an increased odds ratio of dependence in each of these activities. Analysis by radiographic grade, however, demonstrates substantially lower and odds ratios for those elders with asymptomatic grade 2 osteoarthritis. Subjects with symptomatic osteoarthritis or asymptomatic osteoarthritis ≥ grade 3 had substantially increased odds for dependence in both lower extremity ADL. Elders who were classified as "arthritic" using symptom-based definitions had moderately increased odds for dependence in both lower extremity tasks.

Table 4 displays the odds ratios for dependence in each of the five complex ADL that combine both upper and lower extremity function. The largest proportion (27 percent) of disabled elders was found among those who relied upon human assistance for heavy home chores; there was little functional dependence among our subjects in the other four activities.

Considering all elders with any radiographic osteoarthritis as a single group showed very modest increased odds for dependence in any complex ADL. Subjects with asymptomatic grade 2 osteoarthritis showed no increased odds for dependence in these five activities. Elders with asymptomatic OA ≥ grade 3 had increased risks for dependence in housekeeping and carrying bundles. The odds for dependence among elders with symptomatic radiographic disease

TABLE 1—Sex and Age of Subjects (N = 1416)

	Male		Female	
Subjects	N	%	N	%
Sex	589		827	
Age (years)				
≤69	227	38.5	300	36.3
70–79	270	45.8	413	49.9
≥80	92	15.2	114	13.8
mean ± SD	72.6 ± 6.11		72.7 ± 5.98	
range	64–92		63–93	

TABLE 2—Odds Ratios for Dependence upon Human Assistance in One or More Functional Activities Aggregating All Grades of OA and All Reports of Knee Symptoms Adjusted for Age and Sex

	Proportion Disabled	(%)	Adjusted OR	(95% CI)
No OA, no knee symptoms	261/875	(29.8)	1.0	
All Radiographic Grades ≥ 2	172/459	(37.5)	1.25	(0.97, 1.60)
All Knee Symptoms	73/158	(46.2)	1.85	(1.30, 2.65)

TABLE 3—Odds Ratios for Dependence upon Human Assistance to Perform Lower Extremity Activity by Grade of Osteoarthritis and Presence of Knee Pain Adjusted for Age and Sex

Activity	Proportion Disabled	(%)	Adjusted OR	(95% CI)
Stairclimbing				
All subjects	42/1321	(3.2)		
No OA, no knee symptoms	17/869	(2.0)	1.0	
All Radiographic Grades ≥ 2	25/452	(5.5)	2.67	(1.42, 5.04)
Asymptomatic grade 2 OA	8/204	(3.9)	1.89	(0.80, 4.47)
Asymptomatic ≥ grade 3 OA	9/148	(6.1)	2.97	(1.28, 6.87)
Symptomatic ≥ grade 2 OA	8/100	(8.0)	3.84	(1.60, 9.22)
All Knee Symptoms	13/157	(8.3)	3.72	(1.75, 7.93)
No radiographic OA	5/57	(8.8)	4.41	(1.54, 12.64)
≥grade 2 OA	8/100	(8.0)	3.38	(1.39, 8.21)
Walking A Mile				
All subjects	184/1293	(14.2)		
No OA, no pain	96/852	(11.3)	1.0	
All Radiographic Grades ≥ 2	88/441	(20.0)	1.71	(1.23, 2.37)
Asymptomatic grade 2 OA	26/201	(12.9)	1.02	(0.63, 1.65)
Asymptomatic ≥ grade 3 OA	32/139	(23.0)	2.03	(1.27, 3.23)
Symptomatic ≥ grade 2 OA	30/101	(29.7)	2.90	(1.77, 4.75)
All Knee Symptoms	42/156	(26.9)	2.62	(1.71, 4.01)
No radiographic OA	12/55	(21.8)	2.16	(1.08, 4.31)
≥ grade 2 OA	30/101	(29.7)	2.87	(1.75, 4.70)

were slightly elevated in four of these tasks. The largest increased odds for dependence in complex ADL except cooking were found for those elders with knee pain but without radiographic disease.

Discussion

These results indicate the need for a specific definition of disease in the study of arthritis and disability in the elderly. Studying generic "arthritis" may underestimate the impact of osteoarthritis on physical disability in the elderly and obscure the task-specificity of that relationship. Our data demonstrate that dependence associated with knee osteoarthritis varies according to the criteria used to define osteoarthritis and show that knee osteoarthritis does not affect all types of functional activities equally. The magnitude of risk is clearly diminished when all degrees of osteoarthritis are combined, or minor radiographic changes are counted as osteoarthritis. Conversely, the odds are higher when definitions based upon symptom reporting are used. Our findings may help to explain the results of other studies. For example, a previous study of hand function and disease severity by Baron and colleagues[7] found little relationship between osteoarthritis severity measured radiographically and hand function. These investigators included all subjects with radiographic changes ≥ grade 2 in a single "osteoarthritis" category, which may explain the lack of association.

Summated indices of function that include many items unaffected by osteoarthritis may obscure the highly task-specific nature of these limitations, which, in the case of knee osteoarthritis, appear confined primarily to the lower extremity. The task specificity of osteoarthritis-related disability may explain the findings of Summers and coworkers[17] in their study of hip or knee osteoarthritis and functional disability in the elderly. Using 11 subscales from the Sickness Impact Profile (SIP), these investigators noted that only the correlation between disease severity and the SIP ambulation subscale was significant. This finding corroborates our own regarding the task-specific impacts of knee osteoarthritis on elderly function.

TABLE 4—Odds Ratios for Dependence upon Human Assistance to Perform Complex Activities of Daily Living by Grade of Osteoarthritis and Presence of Knee Pain Adjusted for Age and Sex

Activity	Proportion Disabled	(%)	Adjusted OR	(95% CI)
Housekeeping				
All subjects	71/1218	(5.8)		
No OA, no knee symptoms	42/799	(5.3)	1.0	
All Radiographic Grades ≥ 2	29/419	(6.9)	1.12	(0.68, 1.85)
Asymptomatic grade 2 OA	5/196	(2.6)	0.39	(0.15, 1.01)
Asymptomatic ≥ grade 3 OA	14/132	(10.6)	1.80	(1.93, 3.48)
Symptomatic ≥ grade 2 OA	10/91	(11.0)	1.86	(0.88, 3.92)
All Knee Symptoms	15/143	(10.5)	1.83	(0.96, 3.48)
No radiographic OA	5/52	(9.6)	1.90	(0.70, 5.16)
≥ grade 2 OA	10/91	(11.0)	1.80	(0.84, 3.83)
Heavy Home Chores				
All subjects	346/1310	(26.6)		
No OA, no knee symptoms	215/860	(25.0)	1.0	
All Radiographic Grades ≥ 2	133/450	(29.6)	1.10	(0.84, 1.43)
Asymptomatic grade 2 OA	52/205	(25.9)	0.89	(0.62, 1.29)
Asymptomatic ≥ grade 3 OA	46/144	(31.9)	1.24	(0.83, 1.84)
Symptomatic ≥ grade 2 OA	35/101	(34.7)	1.37	(0.87, 2.15)
All Knee Symptoms	51/158	(36.1)	1.51	(1.04, 2.20)
No radiographic OA	22/57	(38.6)	1.85	(1.04, 3.27)
≥ grade 2 OA	35/101	(34.7)	1.35	(0.85, 2.12)
Cooking				
All subjects	34/1211	(2.8)		
No OA, no knee symptoms	23/791	(2.9)	1.0	
All Radiographic Grades ≥ 2	11/420	(2.6)	0.93	(0.44, 1.95)
Asymptomatic grade 2 OA	4/196	(2.0)	0.74	(0.25, 2.18)
Asymptomatic ≥ grade 3 OA	5/131	(3.8)	1.21	(0.45, 3.27)
Symptomatic ≥ grade 2 OA	2/93	(2.2)	0.88	(0.20, 3.86)
All Knee Symptoms	2/142	(1.4)	0.58	(0.13, 2.50)
No radiographic OA	0/49	(0.0)		
≥ grade 2 OA	2/93	(2.2)	0.88	(0.20, 3.84)
Grocery Shopping				
All subjects	54/1209	(4.5)		
No OA, no knee symptoms	34/797	(4.3)	1.0	
All Radiographic Grades ≥ 2	20/412	(4.9)	1.94	(0.53, 1.69)
Asymptomatic grade 2 OA	8/196	(4.1)	0.79	(0.36, 1.77)
Asymptomatic ≥ grade 3 OA	7/126	(5.6)	1.06	(0.45, 2.51)
Symptomatic ≥ grade 2 OA	5/90	(5.6)	1.10	(0.41, 2.93)
All Knee Symptoms	8/139	(5.8)	1.18	(0.52, 2.67)
No radiographic OA	3/49	(6.1)	1.47	(0.43, 5.09)
≥ grade 2 OA	5/90	(5.6)	1.05	(0.39, 2.85)
Carrying Bundles				
All subjects	46/1280	(3.6)		
No OA, no knee symptoms	24/838	(2.9)	1.0	
All Radiographic Grades ≥ 2	22/442	(5.0)	1.31	(0.71, 2.42)
Asymptomatic grade 2 OA	5/205	(2.4)	0.63	(0.23, 1.71)
Asymptomatic ≥ grade 3 OA	12/139	(8.6)	2.47	(1.15, 5.31)
Symptomatic ≥ grade 2 OA	5/98	(5.1)	1.26	(0.46, 3.48)
All Knee Symptoms	9/150	(6.0)	1.62	(0.72, 3.68)
No radiographic OA	4/52	(7.7)	2.88	(0.92, 9.07)
≥ grade 2 OA	5/98	(5.1)	1.18	(0.42, 3.29)

Our previous study of the prevalence of osteoarthritis indicated that the proportions of elders with symptomatic knee osteoarthritis and those with ≥ grade 3 changes increase with age.[10] The present study demonstrates that the dependence in functional activities associated with these particular specifications of knee osteoarthritis varies according to the severity of osteoarthritis and the presence of symptoms. Thus the age composition of the sample is a crucial component of the study of osteoarthritis and disability. Studies of predominately younger elders may not have a sufficient number of cases severe enough to discern the impact of knee osteoarthritis on function.

Aggregated indices of function may be too imprecise with respect to knee osteoarthritis to identify the particular nature of the functional deficits even when the sample has a sufficient number of severe cases. This study underscores the critical importance of choosing functional measures that can identify disability and also be meaningful in terms of the range of tasks and activities typically performed by elders. Using items that measure complex ADL only, e.g. cooking, we would have been unable to capture much of the relationship of knee osteoarthritis to physical disability. The difficulty of choosing discriminating functional measures is further complicated when the research interest focuses on physical function across diseases. "Walking a mile" serves as a case in point. The results of this study indicate that this task successfully identifies osteoarthritis-related disability, at least among the relatively more severe cases. It is also intuitively applicable to other important diseases of the elderly, e.g. cardiovascular diseases, but one must question how meaningful as an essential basic task walking a mile is within the context of an elder's daily activity.

The association of knee osteoarthritis and knee pain with lower extremity disability is not surprising. It is not clear, however, why severe knee osteoarthritis (≥ grade 3) should also be associated with limitations in housekeeping and carrying bundles, and not with other complex ADL. Biomechanical analyses of joint function and studies of muscle performance during these tasks may uncover why this particular degree of joint changes affects these ADL, but not others. Possibly these tasks also reflect choices made by elders. Functional activities are also sociological phenomena, not merely indicators of physical capacities for activity or disease outcomes. It is usually not a cultural expectation or a personal necessity to do heavy chores such as shoveling snow. On the other hand, elders may have little choice with regards to preparing their own meals. Light housekeeping and carrying bundles may be two tasks which elders can elect to perform, and therefore are sensitive to mild disability in elderly populations.

Our study indicated that a substantial number of elders without frequent symptoms had increased odds of disability. This association may be explained, in part, by the wording of our symptom question which required pain to persist for most days of a month. Pain in osteoarthritis is typically elicited by movement of the joint. Therefore, those elders with asymptomatic osteoarthritis ≥ grade 3 may be asymptomatic precisely because they avoid the tasks that would exacerbate the symptoms. If this is the case, then the impact of symptomatic radiographic disease on complex ADL may easily be underestimated given the transient activity-induced nature of pain in osteoarthritis. Questioning subjects on the presence of pain when performing each task might be more productive in demonstrating a relationship among osteoarthritis, pain, and functional disability.

Our data indicate that using knee pain as a proxy measure of arthritis, as might be done in studies using self-reported arthritis, has strengths and weaknesses. Defining osteoarthritis on the basis of symptoms alone did manage to capture many individuals with radiographic evidence of disease. The 57 elders reporting knee pain without radiographic disease may have had other related knee problems (e.g. anserine bursitis, patelofemoral disease, or referred pain from the hip), which are relevant to the study of musculoskeletal impairment and physical disability. Constructing the definition of arthritis solely on the grounds of knee pain, however, excludes a substantial number of subjects with radiographic disease but infrequent symptoms who also had physical disability. Investigators who do not use radiographs to corroborate self-reported arthritis should evaluate whether this degree of imprecision in classifying patients is consistent with their research goal.

In any case, the presence of symptoms should not be considered a necessary condition for exploring arthritis-related disability, a comment previously made with respect to the format of the National Health and Nutrition Examination Survey I.[18] Similarly, pain and functional limitations also should be explored separately in a clinical encounter.

Comorbidities, which are potential confounders of the association of knee osteoarthritis and physical disability, were not included in the model used to estimate odds ratios in this study. Our previous work has indicated a strong association between marked obesity and knee osteoarthritis.[19] The association of knee osteoarthritis with other conditions such as angina and diabetes, which are themselves associated with physical disability, is unclear and we are currently investigating this issue. Although the magnitude of the association between knee OA and physical disability may change in a more complete model, we do not anticipate that the distinctions found when using different definitions of osteoarthritis will be eradicated.

The disability prevalence estimates of our study are limited to those Framingham elders who were able to appear at the study site for a knee radiograph. Therefore, these estimates do not reflect the disability of elders who were home-bound or institutionalized and more likely to be functionally limited.

Although the present study confined itself to knee osteoarthritis, the methodology of this study is applicable to the study of other diseases. Defining diseases broadly, e.g. "stroke," "pulmonary disorders," or "cancer," allows only for a crude approximation of the relationship between disease and disability in the elderly. Symptomatology in other important medical conditions is also activity-induced. Elders with angina, emphysema or intermittent claudication may have learned over time which activities exacerbate their symptoms. These individuals may readily report that they have not recently experienced symptoms, yet have severely curtailed their level of functional activities. Analyses that contribute to our understanding of physical disability in elders by differentiating subgroups of disease and identifying their associations with particular functional limitations are an essential step in designing effective clinical interventions to remediate these deficits.

In summary, combining all severities of osteoarthritis into "arthritis," on using symptom-based definitions of disease alone, and aggregating all functional activities into a single measure of function obscures two facts: 1) that the degree of association between osteoarthritis and physical disability and the elderly depends on the definition of osteoarthritis; and 2) that the impact of any definition of osteoarthritis on functional status is highly task-specific. Future studies of the relationship of arthritis and physical disability in elders should use specific definitions of osteoarthritis and report the impact of specific severity levels of disease on particular functional activities. Such precision should also benefit our understanding of the relationship of other diseases and physical disability as well.

ACKNOWLEDGMENTS

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Two New Publications Available from MCH Clearinghouse

Two new publications which address the health of mothers and babies have been announced by the Health Resources and Services Administration of the federal government.

- *Nutritional Management of the Pregnant Adolescent: A Practical Reference Guide* is a 182-page manual on how to improve the nutrition of prospective young mothers and thus promote the birth of healthy babies. The manual was published through the joint efforts of HRSA's Maternal and Child Health Bureau, the US Department of Agriculture, and the March of Dimes Birth Defects Foundation.
- *Recommendations from the National Symposium on Genetic Services for Underserved Populations* is a new 41-page booklet based on the recommendations drafted at a symposium in May 1989, urging improved genetic services for the underserved. The symposium was sponsored by the Mid-Atlantic Regional Human Genetics Network and the March of Dimes Birth Defects Foundation; publication of the document was supported by the Health Resources and Services Administration.

Single copies of these publications are available from the National Maternal and Child Health Clearinghouse, 38th and R Streets, NW, Washington, DC 20057. Tel: (202) 625-8410.

The Present and the Future of AIDS and Tuberculosis in Illinois

TIMOTHY R. COTÉ, MD, MPH, MERWYN R. NELSON, PHD, SHARON P. ANDERSON, BA,
AND RUSSELL J. MARTIN, DVM, MPH

Abstract: The relation between the acquired immune deficiency syndrome (AIDS) and tuberculosis (TB) was examined by matching the Illinois AIDS and TB registries. The match group was examined and compared with patients with only one disease by race, method of human immunodeficiency virus (HIV) transmission, site of tuberculous disease, radiographic findings, and results of Mantoux tests. The time of TB diagnosis was centrally distributed around the time of AIDS diagnosis; from this, it was determined that 4.1 percent of AIDS patients develop active TB. Projections for future AIDS cases were made by fitting a polynomial model to historical data. These projections were then used to predict the future impact of AIDS-related TB upon state TB rates. The rise in TB rates call for special efforts to minimize this impact. (*Am J Public Health* 1990; 80:950–953.)

> ". . . many of those who had been long gradually declining took to bed with symptoms of phthisis; in many cases of a formerly doubtful character the disease then became confirmed; in these the constitution inclined to the phthisical. Many, and in fact the most of them, died. . ."
>
> —Hippocrates[1]

Introduction

Since the time of Hippocrates, a special susceptibility to clinical tuberculosis (TB) by those already infirm has been noted again and again. Patients with pre-existing malignancy, silicosis, or renal failure, and those undergoing corticosteroid therapy are all at increased risk for developing TB.[2] Two millennia of clinical observation and recent advances in cellular immunobiology[3] support the same generalized conclusion: insult to the salubrity of the human organism predisposes to TB. Reports that patients with the acquired immune deficiency syndrome (AIDS) are at increased risk for TB are consistent with this principle.

Since 1983, data regarding the AIDS/TB connection have come from hospital patient lists or population-based disease registries. In several studies (see Appendix) it has been possible to determine the proportion of persons with AIDS who develop TB[4–12]; the variation in this figure may reflect variation in the prevalence of tuberculosis infection among human immunodeficiency virus (HIV) transmission categories. In the populations studied to date, AIDS patients who are intravenous drug users or Haitian appear to be at higher risk for TB than other AIDS patients. The experience of central regions of the United States is important to an evaluation of the likelihood of a national resurgence of TB.

This paper reports the co-occurrence of AIDS and TB in Illinois, projections of future AIDS and AIDS/TB cases, and a strategy for control of AIDS-related tuberculosis.

Methods

Using a hybrid method of computerized and manual review, in September 1988 the electronic TB Registry for the State of Illinois was matched to the Illinois AIDS Registry. All TB and AIDS cases met the definitions established by the Centers for Disease Control and in effect at the time the diagnosis was made.[13,14] The electronic TB Registry contained 3,033 cases of TB diagnosed in Illinois from January 1985 to July 1988. By September of 1988, the records of all persons reported to the State in the calendar years 1986 and 1987 and some persons reported in calendar years 1985 and 1988 had been entered into the TB Registry and the AIDS Registry contained all 1,992 AIDS patients reported from 1980 through August 1988. An independent evaluation[15] of the Chicago portion of the AIDS Registry indicated that completeness of reporting was 95 percent.

Three fields were used to match TB Registry cases with AIDS Registry cases: last name, first name, and date of birth. Last names and dates of birth were considered critical fields. To be considered a match, one pair of critical fields had to match exactly and the other pair could vary by no more than a single character or a transposition. Additionally, during manual review first names had to be meaningful equivalents. Exact matches on dates of birth and last name were identified using a personal computer; satisfaction of the match definition was assured by manual review of the computer output.

The projected number of Illinois AIDS cases for 1988 through 1993 was obtained by fitting a third order polynomial ($y = \beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3$) to the case count from 1981 through 1987 and determining the 95 percent confidence intervals around the model.[17,18] "Y" represents the number of cases, "X" the year of projection, and each "β" is a constant coefficient. Goodness-of-fit was measured by the R squared statistic.

Comparisons of patient characteristics predisposing to AIDS were done using Yates-corrected chi-square analysis.

Results

A comparison of all AIDS and TB cases yielded 46 persons with both diseases. A profile of the characteristics of AIDS patients with and without TB is displayed in Table 1. Mantoux test results were available for 20 of these 46 patients; 13 (65 percent) were positive. AIDS patients who were Black were at increased risk of developing tuberculosis (RR = 2.65, 95% CI = 1.50, 4.69) as were persons who had intravenous drug abuse as a risk factor (RR = 1.72, 95% CI = 1.06, 3.49). After stratification, the effects of Black race and HIV were independently significant. Residence and sex were not significantly associated with the development of TB in AIDS patients.

Thirty-nine of the 46 persons (85 percent) with both diseases had pulmonary TB. Of these 39, chest x-ray results were available for 26 patients (66 percent); 18 (69 percent) of

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TABLE 1—Comparison of AIDS Patients with and without Tuberculosis

Variables	% Tuberculosis Yes N = 46	% Tuberculosis No N = 1,946	Relative Risk	95% CI
Risk Factors				
Homosexual/bisexual male	59	75	.49	.28, .88
Gay and IV drug use	9	5	1.80	.66, 4.93
IV drug use only	17	9	2.02	.96, 4.27
All IV drug users	26	14	1.72	1.06, 3.49
Other	15	11	1.40	.63, 3.10
Ethnic Background				
White	33	61	.35	.19, .65
Black	52	29	2.65	1.50, 4.69
Other	15	10	1.24	.53, 2.89
Sex				
Male	96	95	1.08	.27, 4.38
Female	4	5	.93	.23, 3.77
Residence				
Chicago	65	74	.66	.36, 1.20
Cook Co. excluding Chicago	15	9	1.69	.77, 3.73
Other Illinois	20	16	1.18	.58, 2.41

these showed non-cavitary lesions, seven (27 percent) showed cavitary lesions, and one was within normal limits in a patient with positive cultures for *M. tuberculosis*. Seven persons (15 percent) with both diseases had only extra-pulmonary tuberculous disease, and 21 (46 percent) had only pulmonary tuberculosis. Thus 25 persons or 54 percent of cases with both TB and AIDS had extra-pulmonary involvement compared to 16 percent in TB patients nationwide.[16] Disseminated disease was miliary in six persons, involved cervical lymph nodes in four; involvement of gastrointestinal, genitourinary, other lymph nodes, and hematogenous sites occurred in two persons each, and tuberculous involvement of liver, brain, meninges and bone marrow each occurred in one case.

The distribution of intervals between time of TB diagnosis and time of AIDS diagnosis is symmetrical around the time of AIDS diagnosis. This distribution has a mean of .87 months and a standard deviation of 7.27 months. TB was diagnosed within six months of AIDS diagnosis in approximately 70 percent of persons with both diseases. This distribution is consistent with the findings of others[5,7] and forms the basis for the analysis below.

Because the Illinois TB Registry is complete for two consecutive years only, an analysis of limited time periods was performed to determine the fraction of TB patients who also contract AIDS and the fraction of AIDS patients who develop TB. TB Registry cases with TB diagnoses in calendar years 1986 or 1987 were compared to AIDS Registry cases with AIDS diagnoses from July 1, 1986 to June 30, 1987. After manual review of the 2,235 TB patients reported in 1986 or 1987 (years for which the electronic TB Registry held all TB reports), 104 incomplete or duplicate records were eliminated and 2,131 records remained. Of these 2,131 TB patients, 35 (1.6 percent) were also reported as having AIDS at some time from 1980 to 1987.

Persons diagnosed with AIDS from July 1, 1986 to June 30, 1987 (n = 603) could develop TB before or after calendar years 1986 and 1987. Therefore, the fraction of AIDS patients who contracted TB could not be calculated without including some adjustment for such TB cases. Comparison of the AIDS and TB intervals yielded 21 matches. Assuming that the distribution of onset intervals were normal with a mean and standard deviation of the observed distribution, the number of AIDS patients expected to develop TB before or after the two-year interval was calculated, yielding an estimate of four additional TB cases. Thus we estimate that 25 TB/AIDS cases occurred, of which four or 16 percent were undetected and that 4.1 percent of the 603 AIDS patients developed TB (95% CI = 0.0276, 0.0614).[17]

Projections of AIDS and TB/AIDS

Illinois AIDS case data were fitted to the above polynomial with the following coefficients: $\beta_0 = -41.2857$, $\beta_1 = 61.66666$, $\beta_2 = -23.25$, $\beta_3 = 4.083333$. The R squared statistic was .999305. The goodness-of-fit, projected AIDS cases and the 95% CI of the projections[18] are shown graphically in Figure 1.

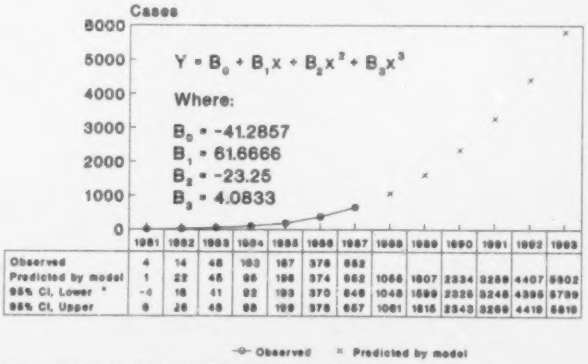
Based on these projections, the centrally distributed AIDS/TB interval, and the proportion of AIDS cases who develop TB (4.1 percent), the number of AIDS patients with TB for each year from 1985 to 1993 was calculated (Table 2, column 4). Subtracting these cases from all TB cases reported and dividing by population figures yielded rates of non-AIDS associated TB (Table 2, column 5). Assuming an unchanged intensity in tuberculosis control measures and a constant 1988 level of non-AIDS associated TB, estimates of future rates for tuberculosis in Illinois can be projected (Figure 2).

Discussion

The reported diagnoses of tuberculosis in AIDS cases characteristically occur near the time of AIDS diagnoses, although this may reflect more careful examination rather than the co-occurrence of disease. The pattern of tuberculous organ involvement is bizarre in AIDS/TB, and radiologic findings are frequently atypical. While the Mantoux test result is often a false negative in AIDS/TB patients, the test remains a useful diagnostic tool.

The recent resurgence of TB in New York[7] and Florida[19] and the sudden arrest of the downward trend in US TB rates[20] have been clearly attributed to TB among AIDS cases. Without intensification of TB control measures, a similar rise in TB incidence can be expected in America's heartland.

The computed projections of TB in Illinois have several limiting deficiencies which need to be addressed. Determination of the proportion of AIDS patients who develop TB was based on a match of AIDS Registry cases who met the early definition of AIDS; the proportion of AIDS patients



	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Observed	4	14	46	103	187	376	662						
Predicted by model	1	22	45	95	196	374	662	1066	1607	2334	3269	4407	5802
95% CI, Lower *	-4	16	41	92	193	370	648	1048	1599	2326	3248	4395	5789
95% CI, Upper	6	26	48	98	199	378	657	1061	1615	2343	3269	4419	5819

* Source: Kmenta, Elements of Econometrics. MacMillan Publishing Co., Inc. New York. 1971. pp. 227-229

FIGURE 1—Comparison of AIDS Cases Reported and Predicted by the Third Order Polynomial

TABLE 2—Historical and Projected Rates of Tuberculosis in Illinois: Unassociated with AIDS and Total Rates

Year	Il. Popul × 1,000	TB Cases Reported	TB/AIDS Cases Computed	TB-only Rate	TB only + TB/AIDS Rate
1982	11,481	1653		14.4	14.4
1983	11,494	1380		12.0	12.0
1984	11,526	1207		10.5	10.5
1985	11,540	1193	8	10.3	10.3
1986	11,555	1144	16	9.8	9.9
1987	11,586	1091	26	9.2	9.4
1988	11,595	1078	44	8.9	9.3
1989	11,603*		67*	8.9*	9.5*
1990	11,612*		97*	8.9*	9.7*
1991	11,633*		135*	8.9*	10.1*
1992	11,654*		182*	8.9*	10.5*
1993	11,675*		239*	8.9*	10.9*

*Projected figures

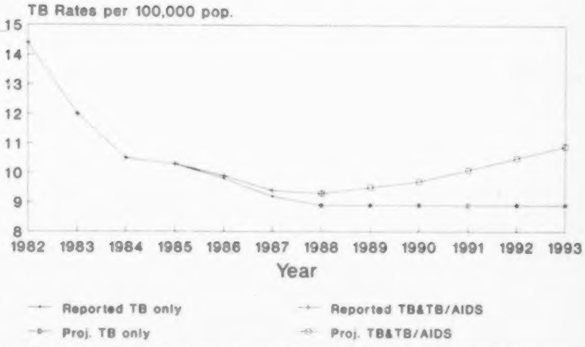


FIGURE 2—Projected Illinois Rates of AIDS-associated and non-AIDS-associated TB

who meet the broader 1987 definition may be different. The projection of future AIDS cases was based on empiric data and may be inaccurate. The assumption of an unchanging rate of tuberculosis unassociated with AIDS assumes no change in the characteristics of the population. The projections do not consider the effect of secondary transmission to uninfected individuals with or without AIDS by AIDS cases with TB. Finally, the projections only extend five years but the most serious public health impact of AIDS-associated TB may occur over the course of decades.

The Reports of the Advisory Committee for Elimination of Tuberculosis[21,22] provides an excellent blueprint for a strategy to minimize the impact of AIDS on future rates of TB. While of undocumented efficacy, early identification and prophylactic treatment of HIV-infected persons who are also infected with *M. tuberculosis* is a reasonable component of such a plan. Specifically, all intravenous drug users should be screened for both HIV and tuberculous infection. Regardless of age, isoniazid preventive therapy should be offered to all TB-infected persons who are intravenous drug users or HIV-infected. Greater utilization of the time-tested public health measures of contact tracing and targeted case finding is indicated at this critical juncture as the epidemiology of TB changes. Prompt recognition of this new group of infectious individuals will only be achieved by a heightened awareness by clinicians of the variegated presentations of TB in HIV-infected persons. Undoubtedly, these measures require a political conviction to confront the resurgence of a nearly vanquished disease and an allocation of resources commensurate with such conviction.

APPENDIX

Literature Review: AIDS and Tuberculosis

Author	Location	AIDS Population N =	R/H* Study	% IVDU§	% Haitian	%TB in AIDS Population
Louie[4]	New York City	280	H	32		8.6
Hadler[5]	Connecticut	299	R			6.0
Handwerger[6]	New York City	386	H	33		7.8
Stoneburner[7]	New York City	4,892	R	29	3	5.3
Sunderam[8]	New Jersey	136	H	75	6	21.3
Murray[9]	Multi-regional	1,067	H	70		1.4
Maayan[10]	Westchester County, NY	40	H	70	2	10.0
Pitchenik[11]	Florida	82	R		54	34.1
CDC[12]	24 States & 4 Loc.	15,181	R			4.2

*Registry or Hospital-based study
§Intravenous Drug Users

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Agreements Signed to Establish European Center on Environment/Health

The WHO Regional Director for Europe, Dr. J. E. Asvall, signed agreements in mid-June with officials in Italy and the Netherlands to establish a European Center on Environment and Health, with units in Rome, Italy, and Bilthoven, Netherlands. Together the two units will form a single WHO Center which will become an integral part of the WHO Regional Office for Europe. By early 1991, each unit will have interdisciplinary teams of scientists and support staff and will be fully equipped to greatly expand the existing European program of WHO in the field of environment and health.

The proposal to establish a Center was made last year by the Frankfurt Conference when Ministers from 29 countries approved a European Charter on Environment and Health. One of the key recommendations was to carry out a feasibility study for such a Center and this was accomplished early in 1990. An agreement was reached to establish a single Center with units adjacent to the Institute for Public Health and Environmental Protection (RIVM) in Bilthoven, Netherlands and adjacent to the Institute of Public Health (ISS) in Rome, Italy. Both these institutions have an international reputation in the field of enviromental health and both will provide strong support to the Center.

A high priority for the Center will be to study the interrelationship between environmental effects and human health. The scientific work of the Center will cover a wide range of activities including health aspects of air and water pollution control, chemical and food safety, radiation protection and occupational health.

The Center will have an initial operating budget of about US $3 million per year and other European countries will be encouraged to actively participate in its work. Facilities are being provided both in Bilthoven and Rome for development of both long-term and short-term staff and for the holding of seminars and other meetings. Equipment will include advanced data processing facilities and there will be complete operational linkages with the WHO Regional Office in Copenhagen and with a wide range of scientific institutions and governmental centers.

The Relationship of Smoking Cessation to Coronary Heart Disease and Lung Cancer in the Multiple Risk Factor Intervention Trial (MRFIT)

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Abstract: The impact of smoking cessation on coronary heart disease (CHD) and lung cancer was assessed after 10.5 years of follow-up in the 12,866 men in the Multiple Risk Factor Intervention Trial (MRFIT). Those men who died of lung cancer (n = 119) were either cigarette smokers at entry or ex-smokers; no lung cancer deaths occurred among the 1,859 men who reported never smoking cigarettes. The risk of lung cancer for smokers, adjusted for selected baseline variables using a Cox proportional hazards model, increased as the number of cigarettes smoked increased (B = 0.0203, SE = 0.0076). There was not the same graded response for CHD among smokers at entry. The risk of CHD death was greater among smokers than nonsmokers (RR = 1.57) (B = −0.0034, S.E. = 0.0048). After one year of cessation, the relative risk of dying of CHD for the quitters as compared to non-quitters (RR = 0.63) was significantly lower even after adjusting for baseline differences and changes in other risk factors. The relative risk for smokers who quit for at least the first three years of the trial was even lower compared to non-quitters (RR = 0.38). However, the relative risk for lung cancer for quitters versus non-quitters was close to 1 both for quitters at 12 months and at three years. These data support the benefits of cessation in relation to CHD and are consistent with other epidemiologic studies which suggest that the lag time for a beneficial effect of smoking cessation on lung cancer may be as long as 20 years. (*Am J Public Health* 1990; 80:954–958.)

Introduction

In the last two decades there have been continuing decreases in coronary heart disease (CHD) mortality rates in all United States populations[1–3] while lung cancer mortality rates continue to increase in certain populations.[4,5] Epidemiologic studies have consistently demonstrated a significantly higher relative risk for smokers compared to former smokers for each of these diseases.[1,2,6–8]

The beneficial effect of smoking cessation on CHD is rapid; as the period of cessation increases, the ex-smoker's relative risk approaches that of the never smoker.[3] However, in one study this return occurred gradually over a 20-year period.[8] The relative risk of developing lung cancer has been demonstrated to decrease as the period of cessation increases for smokers who have stopped smoking,[6–8] but their relative risk is still significantly elevated after 10 to 20 years of cessation compared to lifetime never smokers and is related to both the duration of smoking and length of cessation.[6–8]

In the available studies, the effect of smoking cessation on the risk of developing CHD and lung cancer was estimated either using data gathered retrospectively[6–8] or by considering that smoking habits were unchanged over the period of follow-up.[6,7] It is likely that during the course of these studies some ex-smokers became current smokers and vice versa. In addition, use of retrospective data entails problems of recall, and reports of cessation during the course of follow-up of these studies were not validated with biochemical measures. As a result, the mortality ratios reported for ex-smokers may be too high, and the benefits for cessation may actually be greater than those previously demonstrated for lung cancer and for CHD.

Using the detailed smoking behavior data gathered prospectively in the Multiple Risk Factor Intervention Trial (MRFIT), biochemically validated with serum thiocyanate measurements, we evaluated the relationship of smoking cessation to the development of CHD and lung cancer among middle-aged men, after 10.5 years of follow-up.

Methods

The MRFIT[9–21] was sponsored by the National Heart, Lung and Blood Institute (NHLBI) as a clinical trial, to test the effect of a multifactor intervention program on mortality from CHD. Other objectives included examination of decreases in other mortality and morbidity end points including lung cancer. In summary, the participants were 12,866 men ages 35–57 years at increased risk for CHD and free of overt CHD on entry. Men were designated at increased risk if their levels of the three major CHD risk factors—serum cholesterol, cigarette smoking, and blood pressure—were high enough at first screening to place them in the top 15 percent (later changed to 10 percent for 72 percent of the men screened) of a risk score distribution based on data from the Framingham Heart Study. Men with diastolic blood pressure of 115 mmHg or higher and those with total cholesterol of 350 mg/dl or higher were excluded.

Of the 12,866 men randomized to the special intervention (SI) and usual care (UC) groups, 64 percent (n = 8194) reported smoking cigarettes at the initial screening examinations, an average of 33.9 cigarettes/day. Randomization occurred from December 1973 to February 28, 1976. Thus, on February 28, 1982, when active intervention was terminated, each surviving man had been in the trial for at least six years, with a mean duration of 6.9 years of follow-up from randomization.

All SI men were encouraged and helped to make dietary changes directed at lowering their blood cholesterol levels. The smoking intervention program used an initial intensive group approach as well as individual counseling sessions when indicated. Both approaches included the use of behavioral and cognitive interventions. SI men who were hypertensive (mean diastolic blood pressure greater than or equal to 90 mm Hg on two consecutive visits, or on antihypertensive medication from their personal physicians) were treated with a stepped care approach.[13,18] UC men were not offered

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intervention at the clinical centers and were referred back to their usual source of medical care. They were asked to return to the MRFIT clinical center once a year for a comprehensive evaluation, including assessment of risk factors and morbidity status.

Baseline and annual data collection for both groups during the trial included a medical history and examination, information on past smoking patterns, and reported present cigarettes per day. Serum thiocyanate (Scn) was also measured at baseline and annually to validate reported smoking status. In addition to cigarette smoking, Scn may be elevated by the use of pipes, cigars and cigarillos, certain foods and diuretics.[22] Subjects with an Scn level of more than 100 μ mols/L were assessed to be smoking.

Mortality Ascertainment

During the trial and at termination of active intervention on February 28, 1982, deaths were ascertained by clinic staff through contact with family or friends of the deceased, routine follow-up of missed clinic visits, response to postcards requesting change-of-address information sent twice yearly to UC participants, and searches of publicly accessible files of deceased persons. The main source of vital status information after completion of participation in February 1982 has been the Social Security Administration and the National Death Index. Mortality ascertainment through December 31, 1985 was estimated to be approximately 100 percent complete using these data sources.[18]

The cause of death used in this report is based on death certificate reports. Cause-specific death rates are based on coding of death certificates by trained nosologists, according to the Ninth Revision of the International Classification of Diseases (ICD-9).[23] Each death certificate was independently coded by two nosologists and disagreements were adjudicated by a third nosologist. ICD-9 codes 410 to 414 and 429.2 were used to identify CHD deaths; ICD-9 code 162 was used to identify lung cancer deaths.

Statistical Methods

The SI-UC differences for the end points CHD and lung cancer mortality were tested for statistical significance using the log-rank test.[24] As in other MRFIT publications, 90 percent confidence intervals for the percentage difference in death rates are presented. Mortality rates are presented as number of cases per 1,000 person-years.

The relationship between smoking-related variables and end points was assessed for the combined MRFIT SI and UC smokers at entry into the study using the cox proportional hazards model.[25,26] In one analysis, smokers at entry who attended the first annual examination were classified as *quitters* if they reported not smoking at the first annual examination and had serum Scn levels that were less than 100 μ mols/L, or as *smokers*. In other analyses, smokers at entry who attended the first three annual examinations were classified as persistent quitters, if at each of the three annual examinations they reported not smoking and had serum Scn levels which were less than 100 μ mols/L at each visit, or as *other smokers/quitters*.

Relative risk (RR) estimates and 95 percent confidence intervals for quitters compared to non-quitters were calculated using the proportional hazards regression model. RRs are presented both unadjusted and adjusted for age, baseline blood pressure, cholesterol, number of cigarettes smoked per day, and years of education (as an index of socioeconomic status) added to the model as continuous variables. Differences in baseline characteristics and changes in risk factor levels from baseline to the third annual examination for persistent quitters compared to other smokers/quitters were tested for statistical significance using Student's t test.

Results

As of December 31, 1985, after an average period of follow-up of 10.5 years, there were 1,033 deaths in the MRFIT. There were 146 CHD deaths (3.42/1,000 person-years) among the SI smokers at entry and 165 (3.89/1,000 person-years) among the UC smokers at entry, a relative difference of −12.1 percent (90% CI = −27.1, 5.9). The CHD mortality rates were 2.26/1,000 person-years and 2.44/1,000 person-years for SI and UC non-smokers at entry, respectively. There were 56 lung cancer deaths (1.31/1,000 person-years) among the SI smokers at entry and 50 (1.18/1,000 person-years) among the UC smokers at entry, a relative difference of +11.3 percent (90% CI = −19.2, 53.3). The nine SI and four UC non-smokers at entry who died of lung cancer had been smokers at some point prior to entry into the study.

Mortality in Subgroups Defined after Randomization

Although smoking intervention in the MRFIT resulted in a significantly higher cessation rate for SI compared to UC men ($p < .001$), the lung cancer and CHD mortality rates were not significantly different for these two groups. (Smoking cessation results in the MRFIT will be presented in detail in a subsequent section.) The within group analyses presented in Tables 1–5 are observational, combining data for SI and UC participants.

No lung cancer deaths occurred among the 1,859 MRFIT men who had never smoked cigarettes. Among cigarette smokers there appeared to be a graded relationship between the number of cigarettes smoked per day at baseline, and the lung cancer mortality rate. However, number of cigarettes smoked per day at baseline and risk of CHD mortality did not appear to have as strong a relationship as for lung cancer. Ex-smokers appeared to have a risk of dying from CHD that approached that of never smokers (Table 1).

In the MRFIT study group, never smokers had higher cholesterol and/or blood pressure levels than smokers at baseline in order to be in the top 10 percent of CHD risk. Regression analyses to account for confounders shown in Tables 2 and 3 indicate that only age, the screen 1 cigarettes/day, and baseline Scn are of importance for lung cancer; for CHD mortality age, baseline Scn, DBP, and cholesterol were all significant risk factors ($p < 0.01$). Removing Scn from the regression analysis did not result in a significant relationship between number of cigarettes smoked and CHD risk among smokers.

TABLE 1—CHD and Lung Cancer Deaths and Mortality Rates per 1,000 Person-Years by Number of Cigarettes Smoked per Day at Baseline for MRFIT SI and UC Men Combined

		CHD Deaths		Lung Cancer Deaths	
	Total	N	Rate/1000 Person-Years	N	Rate/1000 Person-Years
Never-smokers	1859	44	2.22	0	0
Ex-smokers	2813	73	2.44	13	0.43
Smokers*					
1–19	856	23	2.56	2	0.22
20–39	3747	173	4.45	50	1.29
≥40	3591	115	3.08	54	1.45

*Number of cigarettes/day smoked

TABLE 2—Regression Coefficients from Cox Proportional Hazards Model for the End Point Lung Cancer Death for MRFIT SI and UC Men Who Reported Smoking Cigarettes at Entry

Variables	Coefficient	SE
Age (years)	0.1239	0.0198
Screen 1 cigarettes/day	0.0203	0.0076
Serum Thiocyanate (μmoles/l)	0.0041	0.0019
Age began smoking (years)	−0.0147	0.0270
Filter/non-filter (1 = filter, 0 = non-filter)	−0.6440	0.4076
Tar	−0.1334	0.0952
Nicotine	1.9110	1.3438
Alcoholic drinks/week	−0.0120	0.0090
Screen 1 DBP (mmHg)	0.0153	0.0155
Screen 1 cholesterol (mg/dl)	−0.0025	0.0030

TABLE 3—Regression Coefficients from the Cox Proportional Hazards Model for the End Point CHD Death for MRFIT SI and UC Men who Smoked Cigarettes at Entry

Variables	Coefficient	SE
Age (years)	0.0626	0.0104
Screen 1 cigarettes/day	−0.0034	0.0048
Serum Thiocyanate (μmoles/l)	0.0029	0.0011
Age began smoking	−0.0127	0.0154
Filter/non-filter (1 = filter, 0 = non-filter)	−0.3337	0.2447
Tar	0.0489	0.0567
Nicotine	−0.9942	0.7927
Alcoholic drinks/week	−0.0150	0.0055
Screen 1 DBP (mmHg)	0.0317	0.0091
Screen 1 cholesterol (mg/dl)	0.0047	0.0017

CHD and lung cancer mortality rates for all men who quit smoking during the first year were compared with the rates of those who continued to smoke (Table 4). The total group of smokers who reported quitting in year one and had Scn <100 μ mols/L had a relative risk of dying from CHD .63 that of non-quitters. The relative risk estimate adjusted for entry risk variables were similar to unadjusted estimates (Table 4). The quitters had the same lung cancer mortality rate from year one to the end of the trial as those who were non-quitters at year one (Table 4). (This was true regardless of baseline levels of smoking or whether they were in the UC or SI group.)

TABLE 4—Number of CHD and Lung Cancer Deaths and Mortality Rate (per 1,000 person-years) from the 12-month visit through 12/31/85[a] for Baseline Smokers by Smoking Status at 12 months, and Relative Risk Estimates (Quitters/Not Quitters) for MRFIT SI and UC Men

Smoking Status	# of Participants SI + UC	Deaths SI + UC	Relative Risk Quit/Not Quit (95% CI)	Adjusted Relative Risk[d] (95% CI)
		Coronary Heart Disease		
Quit[b]	1365	33 (2.54)[c]	.63 (.44,.90)	.58 (.40,.84)
Not Quit	6298	239 (4.04)		
		Lung Cancer		
Quit[b]	1365	17 (1.31)[c]	0.99 (.59,1.67)	1.05 (.62,1.79)
Not Quit	6298	78 (1.32)		

[a] This represents an average of 9.5 years of followup

[b] Quitters are S_1 smokers who reported no smoking at year 1 with SCN <100 μ moles/L.

[c] Rates per 1000 person-years.

[d] Adjusted for age, baseline cigarettes/day, cholesterol, blood pressure. education

We also looked at persons who had quit smoking for at least the first three years of the trial (persistent quitters). Compared to the continuing smokers, the persistent quitters experienced a reduced risk of CHD death (RR = .38) but no change in risk of dying of lung cancer (Table 5). These comparisons are limited by the small number of quitters who persisted for three years which was less than the number who persisted for one year. (Participants who died in the first three years of the trial are also not included.) Persistent quitters were also lighter smokers than those who did not persist (average 30.1 vs 34.2 cigarettes per day).

Persistent quitters and continuing smokers had differences in baseline risk factors and in changes in other risk factors through the three years the two groups were compared. On average, persistent quitters smoked four fewer cigarettes per day and drank 2.2 fewer alcoholic drinks per week at baseline than did other smokers or short-term quitters. Persistent quitters experienced significantly greater weight gain by three years than other smokers or quitters. Adjusting for the differences in risk factors at baseline did not change the relative risk estimates (0.38 versus 0.35), nor did adjusting for the differences in risk factor changes (RR = 0.36, 95% CI = 0.20, 0.65). Likewise, none of these models produced changes in relative risk estimates for lung cancer.

The distribution of lung cancer deaths throughout the span of the trial does not indicate any difference in early versus late mortality by randomization status. Therefore, there is no evidence to date for a trend toward fewer SI as compared to UC lung cancer deaths as time from entry becomes longer, or closer to the 10.5 year maximum follow-up. Because of the relatively small number of participants who were long-term quitters of three or more years and died of lung cancer, it is not possible to evaluate whether the lung cancer death rates might be declining in the latter years of the trial among persistent quitters.

Cessation and Relapse Patterns

Although CHD and lung cancer mortality rates were not significantly different between the randomized groups, smoking cessation rates were significantly different for SI compared to UC men (Figure 1). The cross-sectional data indicate that, throughout the six years of follow-up in the trial, cessation rates for SI smokers were approximately 17 percentage points greater than they were for UC smokers.

TABLE 5—Number of CHD and Lung Cancer Deaths and Mortality Rate (per 1,000 person-years) from the 36-month visit through 12/31/85[a] for Baseline Smokers by Smoking Status at 36 months, and Relative Risk Estimates (Quitters/Not Quitters) for MRFIT SI and UC Men

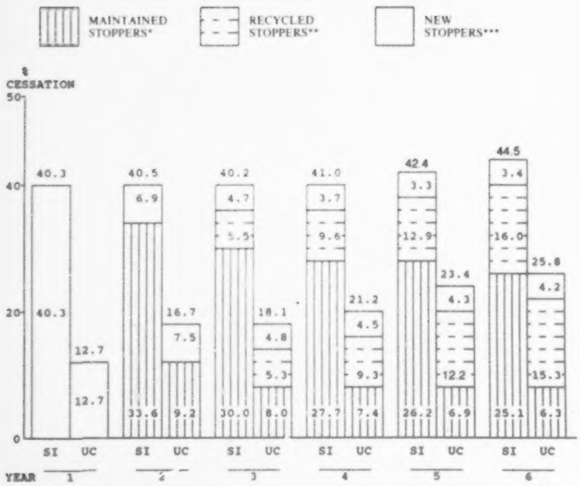
Smoking Status	# of Participants SI + UC	Deaths SI + UC	Relative Risk Quit/Not Quit (95% CI)	Adjusted Relative Risk[d] (95% CI)
		Coronary Heart Disease		
Quit[b]	908	12 (1.72)[c]	0.38 (.21, .68)	0.35 (.20,.63)
Not Quit	6035	205 (4.52)		
		Lung Cancer		
Quit[b]	908	9 (1.29)[c]	.96 (.48,1.93)	1.02 (.50,2.05)
Not Quit	6035	61 (1.34)		

[a] This represents an average of 7.5 years of followup

[b] Quitters are S_1 smokers who reported no smoking at years 1, 2 and 3 with Scn <100 μ moles/L.

[c] Rates per 1000 person-years

[d] Adjusted for age, baseline cigarettes/day, cholesterol, blood pressure, education



If missed visit then participant is assumed smoking.
Cessation rates are adjusted for death.
*Smokers who maintained cessation from year one to the noted year of follow-up.
**Smokers who stopped, relapsed and stopped again; or smokers who stopped after year one and remained off cigarettes.
***Smokers who had not previously reported cessation in the trial but stopped after noted annual examination.

FIGURE 1—Distribution of Smoking Cessation History for Each Annual Visit for Special Intervention(SI) and Usual Care(UC) Smokers.
***Smokers who maintained cessation from year one to the noted year of follow-up.**
****Smokers who stopped, relapsed and stopped again; or smokers who stopped after year one and remained off cigarettes.**
*****Smokers who had not previously reported cessation in the trial but stopped after noted annual examination.**

(Reported rates are used in Figure 1 because by year six there was very little discrepancy between the reported rates and the rates validated by serum Scn.) Cross sectional data do not indicate what proportion of smokers stopped and continued off for the duration of the trial. Cohort data (vertical striped bar) indicate that 25 percent of the SI smokers (60 percent of those who quit in year one) remained abstinent through year six of the trial. For the UC smokers, 6.9 percent (54 percent of those who quit in year one) remained abstinent through year six.

The three groups—maintained stoppers, recycled stoppers, and new stoppers—were calculated for light (<25 cigarettes/day) versus heavy (≥25 cigarettes/day) smokers for the SI and UC groups, respectively. There were lower cross-sectional cessation rates among heavy smokers compared to light smokers in both the SI and UC groups; an approximately two-fold difference in maintained cessation rates for light versus heavy smokers; and a four-fold difference for SI versus UC smokers. For example, only 19.4 percent of SI heavy smokers stayed off of cigarettes for the six years of the trial and only 5.2 percent of UC heavy smokers did so.

Discussion

Smoking cessation during the trial had a substantial and fairly rapid beneficial effect on CHD mortality. The lack of an observable beneficial effect of stopping smoking on lung cancer at the 10.5 year follow-up may in part reflect the long lag period associated with the development of lung cancer. The MRFIT data are consistent with observational studies of lung cancer and smoking cessation indicating that the effect of smoking cessation is related to length of cessation and that there is still a substantial increase in risk for lung cancer among former smokers even after relatively long periods of cessation when compared to never-smokers.[6-8] Given that the MRFIT smoking data were prospectively collected, biochemically validated, and substantially more precise than data from any previous epidemiologic study, they strengthen previous evidence reflecting the immediate beneficial effect of smoking cessation on CHD and the long lag period with respect to a potential beneficial effect on lung cancer.

The sample size estimate for the MRFIT was based on CHD end points and changes in multiple risk factors. Therefore, it was not designed to detect the specific effect of smoking cessation nor differences in lung cancer mortality, which has a lower incidence than CHD mortality. The 90 percent confidence interval bounds for the +11.3 percentage point difference in lung cancer mortality rates for SI compared to UC smokers ranged from −19.2 to +53.3 percent. It is therefore unlikely that a substantial effect (i.e., greater than 20–30 percent lower lung cancer mortality for SI smokers), was missed due to lack of power.

To our knowledge, the MRFIT is only the second intervention trial which has examined the relationship between lung cancer mortality and smoking in randomized groups. The first such trial was the Whitehall Civil Servants Smoking Intervention Trial carried out by Rose and his colleagues.[27] After 10 years of follow-up, there were 22 lung cancer deaths in the intervention group and 25 in the normal care group. Intervention subjects (N = 714) reported a significant net decrease of 7.6 cigarettes/day compared to the control subjects (N = 731) after nine years of follow-up. This trial did not have adequate power to detect a difference in lung cancer. In addition, no objective measures of smoking were obtained. There are no data available from this trial with regard to persistence of quitting or cessation and maintenance rates for heavy versus lighter smokers.

The data confirm results from studies indicating an overwhelming smoking effect on lung cancer risk, with a greater relative risk for heavier smokers as compared to lighter smokers.[1,2,4,6-8] We found no effect of tar or nicotine levels on lung cancer either by univariate or multivariate analysis, suggesting that smokers should not develop a false sense of security by switching to lower tar and nicotine cigarettes.

In previous analysis, we have shown that dose of smoking is an important CHD risk factor when MRFIT smokers and ex-smokers are combined.[13,18] However, the number of cigarettes smoked per day at entry had little effect on risk for CHD when the analysis was limited to smokers only. In part, this is due to the multifactorial etiology of CHD, and may also be related to the focus of MRFIT recruitment on high-risk men, yielding a skewed distribution with a preponderance of relatively heavy smokers. Using a multivariate Cox Proportional Hazard model, baseline Scn level, which is a better marker of acute dose of exposure to cigarettes than reported number of cigarettes smoked, had a significant effect on CHD risk among smokers.

Quitters tended to gain more weight than non-quitters. However, the differences were modest and did not affect the relative risk estimates for CHD of quitters compared to non-quitters when included in the model. CHD deaths did occur among never-smokers, also confirming the multifactorial etiology of CHD.[3,28-34] By the nature of the MRFIT inclusion criteria, those individuals who were non-smokers on entry into the trial had relatively higher levels of serum cholesterol and blood pressure.

In most studies, a large number of persistent quitters is not available to adequately test the relationship of smoking cessation to reduction in death rates; and most persistent quitters are lower risk, lighter smokers. This lack of persistent quitters is likely to attenuate the relationship between cessation and risk. If many years of persistent quitting is required to produce a beneficial effect on lung cancer mortality rates, it will be difficult to carry out studies to demonstrate such an effect.

The disparity in the beneficial effects of smoking cessation observed in this study between lung cancer and CHD mortality may help to explain the disparity seen nationally between sharply decreasing CHD mortality rates and lung cancer mortality rates which show little change. The greater smoking prevalence in earlier birth cohorts also accounts in part for the persistent high lung cancer death rates in these older individuals. Furthermore, some older smokers may have avoided cardiovascular death by smoking cessation and may now be at high risk of lung cancer, further increasing the pool of lung cancer susceptibles.

Lung cancer continues to be a major public health problem. Prevention of smoking and cessation at the youngest possible age for those individuals already smoking are the most important determinants of the future trends of lung cancer mortality.

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Onset of Fertility-Related Events during Adolescence: A Prospective Comparison of Mexican American and Non-Hispanic White Females

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Abstract: Ethnic differences in the first occurrence of fertility-related events are assessed for non-Hispanic White and Mexican American female adolescents. A community-based sample of 1,023 females ages 13 to 19 years was interviewed in 1984–85; 874 (85.4 percent) were reinterviewed approximately two years later. Mexico-born Mexican Americans have the lowest rate of early sexual intercourse, but the highest rate of early births because they are most likely to become pregnant if sexually active, and most likely to have a birth if pregnant. Non-Hispanic Whites have the highest rate of early sexual intercourse, but the lowest rate of early births because pregnant non-Hispanic Whites terminate pregnancies most often. US-born Mexican Americans are intermediate between the other two groups. Delays in the onset of sexual activity among Mexican Americans are not converted into corresponding delays in first pregnancies and births. Early marriage among Mexico-born Mexican Americans, however, accounts for much of the ethnic difference in early fertility. (*Am J Public Health* 1990; 80:959–963.)

Introduction

The well-known health, social, and economic costs associated with teenage fertility have made the prevention of teenage pregnancy a public health priority, particularly in the context of comparatively high US rates.[1] The early initiation of sexual intercourse lengthens the period of risk for teenage pregnancy; an additional consideration is the high rate of sexually transmitted disease among teens and the associated risk of HIV (human immunodeficiency virus) infection. Comparison of intergroup differences in teenage sexual initiation, contraception, pregnancy, abortion, and fertility have focused almost exclusively on the substantial differences existing between Black and White adolescents.[1–5] Comparatively little research has examined early fertility-related behavior among Hispanics in general or among discrete Hispanic subgroups. Yet recent research indicates that fertility among teenagers of Hispanic or Latino ethnic background is closer to the high rate of Black teens than to the lower rate of non-Hispanic White teens.[6–12]

Information about discrete Hispanic groups is limited because Hispanics often are analyzed as a single, undifferentiated social group. Mexican-origin women, however, have markedly higher fertility rates than Puerto Rican and Cuban women.[9] Similar intraethnic heterogeneity apparently exists among teens and young women.[7–10]

For Mexican American females, rates of early sexual intercourse, contraception, and abortion appear to be relatively low, in contrast to comparatively high rates of early fertility. A 1979 household survey of four border states revealed that Mexican American teenagers (15 to 19 years) were less likely than non-Hispanic Whites to be sexually active, and that sexually active Mexican Americans were less likely than non-Hispanic White teens to contracept.[14] We have shown that a high birth rate among Mexican American teens can be attributed to a small base of sexually active females who become pregnant and who elect live births (rather than abortions) at rates higher than the comparatively large base of sexually active non-Hispanic Whites.[12] High early fertility rates among Mexican American females, therefore, may coincide with relatively low rates of early sexual intercourse as a result of especially low rates of contraception among sexually active teens and/or low rates of abortion among pregnant teens.

This report extends previous research by examining multiple fertility-related events (early sexual intercourse, pregnancy, live births, and abortions) utilizing a prospective panel survey of a community-based sample. It also examines differences between Mexican American adolescents born in the United States and those born in Mexico.

Methods

Sample

The data for this study were derived from two sets of interviews conducted with an area probability sample of Los Angeles County Mexican-American and non-Hispanic White adolescent females. Time 1 interviews were conducted between January 1984 and May 1985 and time 2 interviews between January 1986 and May 1987. The average interval between completed interviews was 23 months.

A three-stage cluster sampling frame was used to select respondents: census tracts, blocks, and household addresses. Mexican American adolescents were oversampled by sampling two strata of census tracts: those with a high density (17.8 percent or more) of Hispanics and those with a plurality of non-Hispanic Whites. Sampled household addresses were screened to determine eligibility, defined as being a female resident of the household between the ages of 13 and 19 years who self-identified as being either Mexican American, Mexican or Chicano, or as being White and not of the above or other Latin American background.

One eligible respondent per household was selected using a modified version of the Kish selection method.[15] Mexican American households were more likely than non-Hispanic White households to contain more than one eligible adolescent (29.9 percent versus 19.2 percent). The data were weighted to adjust for this selection probability, but unweighted data are reported, following the suggestion of Kish, because weighted and unweighted analyses are virtually identical.[15]

Of 19,258 field-listed addresses, 861 were unoccupied dwelling units, 721 were not successfully screened, and

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16,552 screened households did not contain an eligible adolescent. Of the 1,124 known eligible households, 1,023 (91.0 percent) participated in the survey, 67 (6.0 percent) refused, and the remainder did not participate for other reasons. Of those interviewed, 874 (85.4 percent) were reinterviewed at time 2. Sample sizes for time 1 and time 2, respectively, are: 317 and 284 (90.0 percent) for non-Hispanic Whites; 398 and 358 (90.0 percent) for US-born Mexican Americans; and 308 and 232 (75.3 percent) for Mexico-born Mexican Americans. The cumulative response rate across time 1 and time 2 was 74.7 percent assuming proportional eligibility among unscreened households. The major source of attrition was an inability to locate participants who had moved, which accounted for 85.2 percent of the 149 nonrespondents. In addition, 10.7 percent were lost because of refusals, 1.3 percent were deceased, and 2.7 percent were lost for other reasons. Loss to follow-up was disproportionately high among Mexico-born Mexican Americans and among the sexually experienced, particularly those who had ever been pregnant.[16]

Detailed descriptions of the sampling procedures and characteristics of the sample are provided elsewhere.[12,16] The average socioeconomic status of the adolescent's family is lower for Mexican Americans than for non-Hispanic Whites, which conforms to census data for Los Angeles County.[17] In addition, the sample school dropout pattern conforms to ethnic patterns in the County.[18] In general, the characteristics of the sample are similar to those of the population from which it was selected.

Procedures

Interviews were conducted by professional female staff from the UCLA Institute for Social Science Research, Survey Research Center. Interviews lasted approximately one hour and were conducted in either English or Spanish. All of the time 1 interviews were conducted at the respondent's home, but 13.5 percent of the reinterviews were conducted by telephone, usually because the respondent had moved.

The interviews were similar at the two times and asked about a wide range of fertility-related attitudes and behavior; only a portion of the information obtained is reported here. The respondent's sexual status was ascertained by asking: "Sometimes people refer to sexual intercourse as 'doing sex,' 'having sex,' 'making love,' or 'going all the way.' Have you ever had sexual intercourse?" Respondents who answered in the affirmative were asked a series of questions concerning their sexual experiences including age of first intercourse and number of partners. Those who had ever been pregnant were asked whether each pregnancy mentioned resulted in a live birth, a stillbirth, a miscarriage, or an abortion.

Analysis

Lifetime prevalence estimates are based on the total sample at time 1, and on the reinterview sample at time 2. The combined age distribution for Hispanics and non-Hispanic Whites from the 1980 Census is used as the standard population to calculate sample weights for time 1 and time 2 that are equivalent to the direct standardization method of age-adjustment. Also, for prevalence estimates, the panel data are weighted to adjust for attrition utilizing a predicted probability of being reinterviewed.[19] Due to the complex sample, confidence intervals are probably slightly underestimated.

Survival analysis is employed for age of first intercourse, pregnancy, and birth because those negative on these events had not completed the period of risk. Those negative on events at reinterview are censored at their time 2 age, while those negative at time 1 and lost to follow-up are censored at their time 1 age. For nonmarital events, the married are censored at their age of marriage. Survival functions are evaluated through age 20 years. There are too few abortions across the age and ethnic groups to conduct meaningful analysis. Survival analyses were conducted with the BMDP Statistical Software program P1L.[19] The Savage-Mantel-Cox statistic is used to assess intergroup differences in the survival functions.[20]

Results

As shown in Table 1, the lifetime prevalence of sexual intercourse is substantially higher at follow-up than at base-

TABLE 1—Age-Adjusted Percent Sexual Intercourse, Pregnancy, Live Birth, and Abortion at Baseline and Follow-up by Ethnic Group

Fertility-Related Variable	Total Sample		Sexually Experienced		Ever Pregnant	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Sexual Intercourse						
NHW	34.3 (29.1, 39.5)	61.8 (56.0, 67.6)	—	—	—	—
US-MA	27.8 (23.4, 32.2)	56.5 (51.2, 61.8)	—	—	—	—
M-MA	16.4 (12.2, 20.6)	39.2 (33.2, 45.2)	—	—	—	—
Pregnancy						
NHW	8.8 (5.7, 11.9)	20.4 (15.6, 25.2)	25.7 (17.5, 33.9)	33.0 (25.8, 40.2)	—	—
US-MA	12.1 (8.9, 15.3)	26.0 (21.3, 30.7)	43.6 (34.3, 52.9)	46.1 (39.0, 53.2)	—	—
M-MA	10.6 (7.1, 14.1)	29.1 (23.5, 34.7)	64.7 (51.5, 77.9)	74.4 (65.8, 83.0)	—	—
Live Birth						
NHW	3.3 (1.3, 5.3)	9.0 (5.6, 12.4)	9.7 (4.1, 15.3)	14.6 (9.2, 20.0)	37.9 (19.9, 55.9)	44.4 (31.1, 57.7)
US-MA	7.0 (4.5, 9.5)	18.5 (14.4, 22.6)	25.4 (17.2, 33.6)	32.9 (26.2, 39.6)	58.7 (44.6, 72.8)	72.0 (62.6, 81.4)
M-MA	8.2 (5.1, 11.3)	23.8 (18.6, 29.0)	49.7 (35.8, 63.6)	61.1 (51.5, 70.7)	76.8 (62.2, 91.4)	82.1 (73.4, 90.8)
Abortion (induced)						
NHW	4.8 (2.4, 7.2)	12.5 (8.5, 16.5)	13.9 (7.4, 20.4)	20.3 (14.1, 26.5)	54.1 (35.6, 72.6)	61.4 (48.4, 74.4)
US-MA	2.5 (1.0, 4.0)	3.1 (1.3, 1.9)	9.1 (3.7, 14.5)	5.5 (2.3, 8.7)	21.1 (9.4, 32.8)	11.9 (5.2, 18.6)
M-MA	0.5 (0.0, 1.3)	1.5 (0.0, 3.0)	3.2 (0.0, 8.1)	4.0 (0.2, 7.8)	5.0 (0.0, 12.6)	5.3 (0.2, 10.4)

NOTE: NHW = Non-Hispanic White; US-MA = US born Mexican American; M-MA = Mexico-born Mexican American. Time 2 percents are weighted to adjust for sample attrition. Live birth and abortion percents among the ever-pregnant do not sum to 100 percent because of repeated pregnancies, small numbers of spontaneous abortions, and current first pregnancies. Time 1, Unweighted N, Total Sample: NHW = 315; US-MA = 396; M-MA = 305; Sexually Experienced: NHW = 105; US-MA = 86; M-MA = 41; Ever Pregnant: NHW = 26; US-MA = 33; M-MA = 25. Time 2, Unweighted N, Total Sample: NHW = 281; US-MA = 358; M-MA = 227; Sexually Experienced: NHW = 157; US-MA = 176; M-MA = 74; Ever Pregnant: NHW = 44; MA-US = 72; M-MA = 52. 95% confidence interval in parentheses.

line for all three ethnic groups, as would be expected given that the sample has aged, on average, two years. The prevalence of sexual intercourse is substantially lower among Mexico-born Mexican Americans than among the other two groups, with non-Hispanic Whites having the highest lifetime prevalence of sexual intercourse at baseline and at follow-up.

The percent ever pregnant more than doubles across time for all three groups. Non-Hispanic Whites have the lowest rate of ever having been pregnant at both times, with US-born Mexican Americans and Mexico-born Mexican Americans having the highest rates at time 1 and time 2, respectively. At both times, however, the confidence intervals overlap for all three groups. Among only those who have ever had sexual intercourse, the percent ever-pregnant is substantially higher among Mexico-born Mexican Americans than among non-Hispanic Whites at both baseline and follow-up: US-born Mexican Americans are intermediate between these other groups. The increase across time is modest, indicating a similar risk of pregnancy.

For the percent ever having had a live birth, similar ethnic differences are observed for the total sample, those who have ever had sexual intercourse, and those who have ever been pregnant. This percentage is highest for Mexico-born Mexican Americans and lowest for non-Hispanic Whites. These ethnic differences are more pronounced for the sexually experienced and the ever-pregnant than for the total sample and tend to be somewhat more pronounced at follow-up than at baseline.

Ethnic group differences in abortion mirror the live birth pattern. Non-Hispanic Whites have the highest percent having had an abortion at both times and the greatest increase across time. Among the sexually experienced and the ever-pregnant, the percent who have had an abortion decreases over time among US-born Mexican Americans.

Non-Hispanic White female adolescents are substantially more likely than Mexican-American adolescents to have had multiple sexual partners, although the mode is one partner for all three groups. For non-Hispanic Whites, 29.7 percent have had only one partner, with 12.1 percent having more than 10 partners. For Mexican Americans, 48.9 percent of the US-born and 79.6 percent of the Mexico-born have had only one partner, with 10 being the maximum number of partners in both groups. This difference persists when the number of years of sexual activity is controlled statistically.

The survival functions for age of initiating sexual intercourse differ among the three ethnic groups (Savage-Mantel-Cox statistic = 47.25, d.f. = 2, $p < .001$). As shown in Table 2, the cumulative proportion surviving without initiating intercourse is substantially higher among Mexico-born Mexican Americans than among the other groups from the age of 15 years onwards. The median survival age is substantially older among Mexico-born Mexican Americans (19.7 years) than US-born Mexican Americans (17.8 years), or non-Hispanic Whites (17.4 years).

The hazard rates, the probability of first intercourse at a specific age given no intercourse before that age, also differ by ethnic group, as shown in Table 2. For non-Hispanic Whites and US-born Mexican Americans, marked increases occur between the ages of 15 and 17 years. For the Mexico-born, the hazard rate increases substantially between 17 and 19 years. The peak hazard rate for all three groups is between 18 and 19 years.

Contrastingly, the survival functions for age of first pregnancy are similar across these three groups (Savage-Mantel-Cox = 3.37, d.f. = 2, $p > .10$). The decline in the proportion surviving without a pregnancy is somewhat more marked among the two Mexican American groups than among non-Hispanic Whites, as shown in Table 3. For both Mexican American groups, hazard rates are relatively low until a sharp increase occurs between 17 and 18 years. For non-Hispanic Whites, the hazard rate increases approximately a year later.

Despite similar patterns for pregnancy, there are substantial ethnic differences in the survival functions for first birth (Savage-Mantel-Cox statistic = 13.30, d.f. = 2, $p < .005$). As shown in Table 4, the cumulative proportion surviving without a live birth is similarly high across ethnic groups until age 17 years, and thereafter declines more rapidly among the two Mexican American groups than among the non-Hispanic White group. The pattern for the two Mexican American groups is similar until age 18; thereafter the proportion surviving declines more among the Mexico-born than among the US-born. For non-Hispanic Whites, the hazard rate is highest between the ages of 17 and 18 years. At this age, the Mexican-American groups have a similar hazard rate, but this rate increases further over time.

Ethnic differences in early marriage may contribute to these patterns. The percent ever-married is substantially higher among Mexico-born Mexican Americans (14.3 percent) than among US-born Mexican Americans (6.5 percent) or non-Hispanic Whites (4.7 percent). Moreover, among the ever-married, the Mexico-born are most likely to have married prior to first sexual intercourse, pregnancy, and live birth. For US-born Mexican Americans and non-Hispanic Whites, prevalence rates for nonmarital fertility events are quite similar to those for all events. For Mexico-born Mexican Americans, however, the prevalence rates for nonmarital events are substantially lower than all events. The

TABLE 2—Survival Analysis of Age of First Sexual Intercourse by Ethnic Group

Age (Years)	Cumulative Proportion Surviving			Hazard Rate		
	NHW	US-MA	M-MA	NHW	US-MA	M-MA
12	.981 (.008)	.995 (.004)	.984 (.007)	.019 (.008)	.005 (.004)	.017 (.007)
13	.942 (.013)	.962 (.010)	.970 (.010)	.040 (.012)	.034 (.009)	.014 (.007)
14	.874 (.019)	.928 (.013)	.945 (.013)	.079 (.017)	.033 (.010)	.026 (.010)
15	.767 (.025)	.802 (.021)	.894 (.019)	.130 (.024)	.146 (.022)	.056 (.016)
16	.559 (.031)	.631 (.027)	.831 (.024)	.314 (.044)	.241 (.034)	.072 (.020)
17	.406 (.033)	.475 (.031)	.704 (.033)	.317 (.058)	.282 (.048)	.166 (.036)
18	.273 (.034)	.334 (.033)	.567 (.040)	.391 (.090)	.349 (.073)	.215 (.053)
19	.224 (.036)	.249 (.036)	.465 (.047)	.195 (.097)	.291 (.102)	.197 (.069)
20	.168 (.044)	.187 (.047)	.403 (.057)	—	—	—

NOTE: Standard errors in parentheses. NHW = Non-Hispanic White, N = 314; US-MA = US-born Mexican American, N = 397; M-MA= Mexico-born Mexican American, N = 303.

TABLE 3—Survival Analysis of Age of First Pregnancy by Ethnic Group

Age (Years)	Cumulative Proportion Surviving			Hazard Rate		
	NHW	US-MA	M-MA	NHW	US-MA	M-MA
12	1.000 (.000)	1.000 (.000)	.997 (.003)	.000 (.000)	.000 (.000)	.003 (.003)
13	.990 (.006)	1.000 (.000)	.997 (.003)	.010 (.006)	.000 (.000)	.000 (.000)
14	.984 (.007)	.990 (.005)	.975 (.009)	.007 (.005)	.010 (.005)	.022 (.009)
15	.952 (.013)	.937 (.013)	.943 (.014)	.033 (.011)	.054 (.013)	.033 (.012)
16	.909 (.018)	.898 (.017)	.914 (.018)	.046 (.015)	.043 (.013)	.032 (.013)
17	.876 (.022)	.806 (.025)	.826 (.028)	.037 (.015)	.107 (.024)	.101 (.027)
18	.794 (.031)	.734 (.031)	.755 (.035)	.098 (.030)	.094 (.028)	.090 (.032)
19	.725 (.039)	.636 (.039)	.599 (.049)	.090 (.037)	.144 (.045)	.231 (.066)
20	.636 (.059)	.558 (.054)	.507 (.064)	—	—	—

NOTE: Standard errors in parentheses. NHW = Non-Hispanic White, N = 314; US-MA = US-born Mexican American, N = 396; M-MA = Mexico-born Mexican American, N = 302.

TABLE 4—Survival Analysis of Age of First Live Birth by Ethnic Group

Age (Years)	Cumulative Proportion Surviving			Hazard Rate		
	NHW	US-MA	M-MA	NHW	US-MA	M-MA
12	1.000 (.000)	1.000 (.000)	.997 (.003)	.000 (.000)	.000 (.000)	.003 (.003)
13	1.000 (.000)	1.000 (.000)	.997 (.003)	.000 (.000)	.000 (.000)	.000 (.000)
14	.997 (.003)	.995 (.004)	.993 (.005)	.003 (.003)	.005 (.004)	.004 (.004)
15	.993 (.005)	.974 (.008)	.977 (.009)	.004 (.004)	.021 (.008)	.016 (.008)
16	.980 (.009)	.945 (.013)	.947 (.015)	.013 (.008)	.030 (.011)	.031 (.013)
17	.941 (.017)	.897 (.019)	.909 (.021)	.041 (.015)	.052 (.017)	.041 (.017)
18	.918 (.021)	.799 (.029)	.803 (.034)	.025 (.014)	.116 (.030)	.124 (.036)
19	.895 (.026)	.750 (.035)	.709 (.045)	.026 (.018)	.063 (.028)	.124 (.047)
20	.832 (.049)	.674 (.052)	.643 (.060)	—	—	—

NOTE: Standard errors in parentheses. NHW = Non-Hispanic White, N = 313; US-MA = US-born Mexican American, N = 395; M-MA = Mexico-born Mexican American, N = 299.

cumulative proportion surviving to age 20 years without nonmarital intercourse is .183 (SE = .046) for non-Hispanic Whites, .201 (SE = .050) for US-born Mexican Americans, and .637 (SE = .046) for Mexico-born Mexican Americans (Savage-Mantel-Cox Statistic = 72.25, d.f. = 2, $p < .001$; see Table 2). For nonmarital pregnancy, the three ethnic groups remain similar (Savage-Mantel-Cox Statistic = 3.73, d.f. = 2, $p > .10$), with the proportion surviving to age 20 years being .673 (SE = .060) for non-Hispanic Whites and .616 (SE = .057) for Mexico-born and .695 (SE = .070) for US-born Mexican Americans (see Table 3). In contrast, the survival functions differ by ethnicity for nonmarital births (Savage-Mantel-Cox Statistic = 9.49, d.f. = 2, $p < .01$), with the cumulative proportion surviving to age 20 years being .869 (SE = .048) for non-Hispanic Whites, .772 (SE = .043) for US-born Mexican Americans, and .876 (SE = .052) for Mexico-born Mexican Americans (see Table 4).

Discussion

In sum, non-Hispanic Whites have the lowest level of early fertility despite having the highest level of sexual activity because sexually experienced non-Hispanic Whites are the least likely to become pregnant and because pregnant non-Hispanic Whites are most likely to elect abortion. In sharp contrast, Mexico-born Mexican Americans have the lowest level of early sexual intercourse, but are most likely to become pregnant if they have sexual intercourse, and most likely to have a birth if they become pregnant. Consequently, the Mexico-born have the highest fertility rate. US-born Mexican Americans tend to be intermediate between the other two groups across the various events studied. Age of first pregnancy is similar across the three ethnic groups, but Mexico-born Mexican Americans initiate sexual intercourse at later ages than the other two groups, and both Mexican American groups have first births at earlier ages than non-Hispanic Whites.

The role of early marriage in fertility-related events is most pronounced among Mexico-born Mexican Americans. Only a small proportion of young women in any of these groups marry early, but the somewhat greater propensity of Mexico-born Mexican Americans to do so accounts for most of the difference in early fertility in comparison to non-Hispanic Whites. Early marriage, however, does not account for differences in early fertility between US-born Mexican Americans and non-Hispanic Whites. Thus, while Mexico-born Mexican Americans are most likely to have early births overall, US-born Mexican Americans are most likely to have early nonmarital births.

The estimates of early fertility obtained in this investigation for Los Angeles County females are somewhat below the national estimates provided by Michael and Tuma.[6] These differences may be due to regional effects, the later study date of the present investigation, differences in study procedures, or variation within the Hispanic population. In general, the age-specific rate of first births (see Table 4) closely approximates the 1980 age-specific fertility rate for Los Angeles County for Hispanics and for non-Hispanics Whites.[11] These rates are not directly comparable for a variety of reasons. Nonetheless, this similarity suggests that underreporting of live births by study participants is not a serious source of misestimation.

These data reveal substantial potential risk for adolescent females for transmission of HIV infection or other sexually transmitted disease through multiple sexual partners. All else being equal, non-Hispanic White females would be at highest risk because they have the highest rate of early sexual intercourse and are most likely to have multiple sexual partners. While the relative risk of AIDS is higher among Hispanic than non-Hispanic White men, this higher risk appears limited to Puerto Ricans rather than Mexican Americans.[21] Assuming within-group selection of sexual partners, young Mexico-born Mexican American females, therefore, would appear to be at low risk, due to their relatively late age of initiating sex and generally low number of partners.

Public policy debate concerning teenage pregnancy centers upon the alternatives of primary prevention (reducing risk exposure by delaying the onset of sexual activity) versus secondary prevention (reducing the impact of exposure by increasing effective contraception among the sexually active). The gains that can be achieved through primary prevention are greatest for groups with high exposure, i.e., those who initiate sexual intercourse early—non-Hispanic Whites and US-born Mexican Americans. Relative to these groups, Mexico-born Mexican Americans delay the onset of sexual activity considerably, but nonetheless experience high fertility. Conversely, the gains that can be achieved through secondary prevention are greatest for groups with high rates of pregnancy among the sexually active. Although such pregnancy rates are high for all three ethnic groups, the most vulnerable are the two Mexican American groups—the Mexico-born for all pregnancies and the US-born for nonmarital pregnancies. Effective primary or secondary interventions would serve to diminish early fertility across ethnic groups. Our results suggest, however, that the potential reduction in early births that can be realized at various junctures in the sequence of fertility-related events may differ by ethnicity.

The timing of such interventions is critical. Common wisdom asserts that prevention should commence early, a recommendation supported by the early onset of sexual activity documented here. The high hazard rates during the middle to late teen years, however, indicate that prevention activities should continue throughout the adolescent years. Moreover, given the accelerating pattern of sexual activity with increasing age, the focus of prevention activities should shift over time toward a greater concentration on secondary prevention. Also, such prevention activities need to incorporate consideration of marital as well as nonmarital contraception. Programs that focus solely on preventing nonmarital sexual relations leave young women unprepared for reproductive decisions within marriage.

Finally, public policy and funding decisions pertaining to abortion are likely to impact most upon non-Hispanic White adolescents. While young women in all three ethnic groups terminate pregnancies, non-Hispanic Whites are most likely to resolve pregnancies with abortions. Reduction in the availability of abortion, particularly to juveniles, is therefore likely to increase births sharply among young non-Hispanic Whites, but to have comparatively little impact among young Mexican Americans.

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Prior Condom Use and the Risk of Tubal Pregnancy

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Abstract: The relationship between prior condom use and tubal pregnancy was assessed in a population-based case-control study at Group Health Cooperative of Puget Sound during 1981–86. We interviewed 227 women with a tubal pregnancy who had no clinical indication of infertility and no history of sterilization and 674 similarly defined controls who were matched to the cases on age and county of residence. A history of condom use for more than one year was associated with a decreased risk of subsequent tubal pregnancy (RR = 0.74, 95% CI = 0.44, 1.26) adjusted for the effects of age, current use of contraceptive methods, educational level, and age at first intercourse. The effect was more pronounced when condoms had been used during five-year periods with more than one partner (RR = 0.38, 95% CI = 0.15, 1.0) than during five-year periods with one partner (RR = 0.89, 95% CI = 0.45, 1.76). Condom use for less than one year was unrelated to risk of ectopic pregnancy. Since the use of condoms offers protection against sexually transmitted diseases, one or more of which are likely to be causally related to tubal pregnancy, the observed negative association plausibly represents a protective influence of long-term condom use on the occurrence of tubal pregnancy. (*Am J Public Health* 1990; 80:964-966.)

Introduction

Some sexually transmitted diseases (STDs) are now considered to be major risk factors for tubal pregnancy,[1] and condom use is believed to be protective against sexually transmitted diseases,[2] so condom use should protect women against tubal pregnancy. Nevertheless, direct evidence to support this inference is lacking. We therefore analyzed data gathered in a population-based case-control study to assess whether condom use is associated with a reduced risk of subsequent tubal pregnancy.

Methods

Details of the study methods can be found elsewhere.[3] Briefly, all subjects in this study were members of the Group Health Cooperative (GHC), a health maintenance organization in the Puget Sound area of Washington State. We identified 396 newly diagnosed cases of ectopic pregnancy through a computerized hospital discharge system between October 1981 and September 1986. After 11 (2.8 percent) refusals for participation from patients' physicians, 39 (9.8 percent) refusals from patients themselves, and nine (2.3 percent) lost to follow-up, 337 (85.1 percent) cases participated in the study.

Controls were randomly selected from the GHC membership file from the calendar quarter of the diagnosis of the tubal pregnancy, and were matched to cases on age and county of residence. In order to be eligible for participation in the study, controls had to be at risk of conceiving and being diagnosed with a tubal pregnancy, i.e., sexually active within 12 months prior to the time of being selected; without a male sexual partner(s) who was known to be sterile; and not pregnant, or less than four months pregnant, at the time selected. Of 1,139 controls initially chosen, 32 (2.8 percent) were not available for the study due to their physicians' refusal, 168 (14.7 percent) refused to participate, 46 (4.0 percent) were lost to follow-up. A total of 893 (78.4 percent) control subjects agreed to participate in the study.

A structured personal interview was conducted with each subject to obtain information on demographic characteristics, reproductive history, contraceptive experience, and medical history. Women were asked not only the total number of sexual partner(s) and the age of first intercourse, but also the number of sexual partners during specific intervals: less than 16 years of age, ages 16–20, 21–25, 26–30, 31–35, and 36–40. Details of life-time contraceptive practices included the types of contraceptive methods used, brand (if applicable), starting and ending dates, and the reasons for stopping contraception.

In order to make case and control groups comparable with respect to their opportunity for exposure (i.e., duration of condom use), women with characteristics likely to be related independently to the occurrences of tubal pregnancy—a history of previous sterilization or previous infertility tests—were excluded from the analysis. Furthermore, those with a prior ectopic pregnancy and those whose ectopic pregnancy was not in the fallopian tube were also excluded, leaving 227 cases and 674 controls available for analysis. A "reference date" was established for each subject—the estimated date of conception for cases and the mid-point of that same quarter for controls—and only exposures at and prior to that time were ascertained.

To determine if the association of condom use and tubal pregnancy varied with subject's sexual behavior, the relation was evaluated separately for those five-year periods during which there had or had not been more than one sexual partner.

The odds ratio, accompanied by its 95% confidence interval, was used as an estimate of relative risk. Logistic regression analysis was employed to adjust for potential confounders.[4]

Results

Table 1 presents some characteristics of the study subjects. Age remained comparable between case and control groups after the exclusions made in this study. Compared to controls, cases were more likely to have been married (or living as married) at the date of diagnosis of the tubal pregnancy, to be Black, and to have had less education.

Cases were more likely than controls to have had a greater total number of sexual partners, to have become

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TABLE 1—Characteristics of Cases and Controls

Characteristics	Percentage Cases (N = 227)	Controls (N = 674)
Age (years)		
<20	4.0	2.4
20–24	18.5	18.5
25–29	29.1	30.9
30–34	35.7	34.9
≥35	12.8	13.4
Marital status		
Stable[a]	92.1	83.9
Separated or divorced	4.8	6.4
Never married	3.1	9.8
Race		
White	81.1	87.1
Black	13.7	5.8
Other	5.3	7.1
Education		
>high school	64.3	72.0
Age at first intercourse (years)		
≤16	35.7	23.0
17–19	45.4	43.8
≥20	19.0	33.3
Number of sexual partners, life-time		
One	13.3	27.5
2–4	35.8	31.1
5–14	34.5	28.3
≥15	16.4	13.1
History of gonorrhea		
Yes	12.9	6.9
Current contraceptive use		
No	73.2	19.1
The Pill	5.7	29.1
IUC	7.9	8.8
Other[b]	13.2	42.3

[a] Including married, living as married and regular sexual partnership.
[b] Including barrier methods and withdrawal.

sexually active at an earlier age, and to have had a history of infection with gonorrhea (Table 1). Cases were far less likely than controls to have been using any kind of contraceptive method at the reference date, although use of the intrauterine device (IUD) at that time was comparable between the two groups (Table 1).

The relation between duration of condom use and tubal pregnancy is shown in Table 2. Condom use was associated with a decreased risk of a subsequent occurrence of tubal pregnancy only when it had been used for a relatively long time (i.e., more than one year). After taking into account her age, current contraceptive use, educational level, and age at first intercourse, a woman whose partners used condoms for more than one year during any five-year period in which she had more than one sexual partner had only 38 percent of the risk for subsequent occurrence of tubal pregnancy compared to never-users (95% CI = 0.15, 1.0). Condom use restricted to periods in which the woman had only one sexual partner was not associated with a decreased risk of tubal pregnancy, nor was condom use for less than one year, irrespective of the number of partners. Further adjustment for the following variables did not influence the results: number of life-time sexual partners, history of gonorrhea infection, oral contraceptive and IUD use, reproductive history including gravidity, parity, spontaneous and induced abortion, religious briefs, smoking habits, the year of diagnosis of ectopic pregnancy, family income, and race. The number of five-year intervals in which more than one partner had been present was similar between case and control women, and so this did not produce differences in the size of the association with condom use.

Discussion

Our finding of a negative association between prior condom use and the occurrence of tubal pregnancy might have been anticipated, given that condom use can reduce the risk of transmission of many forms of sexually transmitted diseases, some of which are important etiologic factors for tubal pregnancy. Nonetheless, it is necessary to keep in mind several limitations of our study when interpreting these results. First, our ability to assess exposure to sexually transmitted diseases themselves was extremely limited. We were able to measure only a distant correlate of such exposure—the presence of more than one sexual partner during various periods of a woman's reproductive life. Thus, our finding of a reduced risk of tubal pregnancy associated with condom use restricted to women whose partner's use occurred during periods of her life in which she had more than one partner could be a reflection of yet a far greater protective effect of condom use among women who truly had been exposed to one or more sexually transmitted diseases. On the other hand, we made numerous comparisons in this data set, and the restriction of a negative association to this subgroup of women could have been simply the result of chance.

Second, the control group of women chosen in this study—women capable of becoming pregnant—had certain disadvantages in examining the influence of prior condom use. The use of the particular control group was dictated by our interest in studying the influence of exposures at the time of conception (e.g., IUD use), plus our concern that the commonly used alternative group (women completing an intrauterine pregnancy) provided a substantial opportunity for bias,[5] since a sizable portion of women who conceive a pregnancy do not go on to deliver it. The selection of controls who were believed to be capable of becoming pregnant led to a large case-control difference in the frequency of contraception (of any type, see Table 1) at the reference date. As expected, far fewer cases than controls were attempting to contracept at that time. Nonetheless, since there were sizable numbers of contraceptors and noncontraceptors among both cases and controls, and since we were interested in the effect of condoms on tubal pregnancy above and beyond their ability to prevent pregnancy per se, we were able to adjust for the use of contraception at reference date and thus obtain an unconfounded (with respect to this factor) evaluation of the influence of past condom use.

In our analysis, we sought to address the possibility that the reduced risk among women whose partner(s) had used a condom resulted only from an increased risk associated with use of certain other forms of contraception. First, we restricted the analysis to women who had not been sterilized. Then, we assessed the influence of condom use adjusting for prior use of contraceptive methods that plausibly could affect the occurrence of pelvic infection (and thus tubal pregnancy), i.e., IUDs and oral contraceptives.[1, 6] A negative association between condom use and tubal pregnancy persisted despite such adjustments.

While several studies of tubal pregnancy have examined the influence of barrier methods of contraception in general,[1, 7–10] only our earlier[9] and current studies focused on prior condom use. The earlier study did find a 60 percent reduction in the incidence of tubal pregnancy among women whose partner(s) had used a condom, but neither duration of use nor the further influence of number of partners was analyzed. Although the use of barrier methods in general has been found

TABLE 2—Logistic Regression Results of the Relation between Condom Use and Tubal Pregnancy

	Cases (%)	Controls (%)	Crude RR (95% CI)	RRa[a] (95% CI)
Duration (years) of total condom use				
Never[*]	176 (77.5)	488 (72.4)		
≤1	24 (10.6)	52 (7.7)	1.28 (0.77,2.14)	1.47 (0.79,2.74)
>1	27 (11.9)	134 (19.9)	0.56 (0.36,0.87)	0.74 (0.44,1.26)
Duration (years) of condom use during 5-year time interval in which there was >1 partner				
Never[*]	156 (86.7)	366 (82.1)		
≤1	17 (9.4)	39 (8.7)	1.02 (0.56,1.86)	1.49 (0.72,3.09)
>1	7 (3.9)	41 (9.2)	0.40 (0.18,0.91)	0.38 (0.15,1.00)
Duration (years) of condom use during 5-year time interval in which there was only one partner[b]				
Never[*]	144 (84.2)	400 (78.3)		
≤1	12 (7.0)	39 (7.6)	0.85 (0.44,1.68)	0.94 (0.43,2.05)
>1	15 (8.8)	72 (14.1)	0.58 (0.32,1.04)	0.89 (0.45,1.76)

[*] Reference group.

[a] Risk relative to the women who never used condoms adjusted for age, current contraceptive use, education level and age at first intercourse that were categorized as shown in Table 1.

[b] Women whose partners used condoms during any five-year period in which there had been more than one sexual partner were excluded.

to be associated with a modest reduction in the risk of tubal pregnancy,[7,8,10] the possibly different impact on tubal pregnancy of individual barrier methods limits the interpretation of the results with respect to any one of the methods. In addition, by studying current users versus current non-users,[8,10] previous studies allowed for the possibility that the low risk was due simply to the ability of barrier methods to prevent conception.

In conclusion, after controlling the "need" for contraceptive use, age, current use of contraceptive methods, education level, and age at first intercourse, we found that use of a condom for more than one year reduced the risk of tubal pregnancy. The effect was more pronounced when condom use was during any five-year period in which there had been more than one sexual partner. This observed negative association may plausibly represent a protective effect of long term use of condom on the occurrence of tubal pregnancy through the prevention of one or more sexually transmitted diseases.

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Age and Human Immunodeficiency Virus Infection in Persons with Hemophilia in California

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Abstract: Thirteen hemophilia centers provide comprehensive care to approximately 90 percent of persons with hemophilia in California. For 1987, these centers reported patient human immunodeficiency virus (HIV) antibody status, age group, level of clotting factor deficiency, and hemophilia type on 1,438 persons with hemophilia A and B; HIV serologic status was known for 860 persons (59.8 percent) of whom 537 (62.4 percent) were HIV-antibody-positive. The HIV positivity rate increased with age after taking into account hemophilia type, clotting factor level and treatment center type. The three-year cumulative incidence of reported AIDS (acquired immunodeficiency syndrome) cases based on the number of HIV positive patients, was 11.6 percent. The cumulative incidence rate was 14.6 percent (54 of 370) for those patients over 20 years of age and 4.8 percent (8 of 167) for those under 21 years of age. Although a comparable distribution of the date of diagnoses of AIDS was seen by age group, there appeared to be a bimodal distribution in the rate of AIDS among the age groups, with the 6–12-year-olds and the 21 and older age groups showing higher incidence rates. (*Am J Public Health* 1990; 80:967–969.)

Introduction

Acquired immunodeficiency syndrome (AIDS) was first documented in persons with hemophilia early in the course of the AIDS epidemic in the United States.[1] Studies of stored serum specimens showed that a high percentage of hemophilic persons became infected with human immunodeficiency virus (HIV) over a relatively short time. Most patients became infected between 1981 and 1984; the peak incidence of infection occurred in 1982 and 1983.[2,3] The reasons for the quick spread of infection in this population were the widespread use of commercial clotting factor concentrates prepared from pools of sera collected from between 2,000 to 20,000 donors[4] and the widening prevalence of this infection in the United States, and therefore in the donor population, before HIV blood screening practices were in effect.

The Centers for Disease Control (CDC) collects data characterizing AIDS in the United States hemophilic population through state health departments.[5,6] This reporting mechanism has been exceptionally efficient, with at least 97 percent of the cases reported.[5]

The duration of HIV infection before the onset of AIDS varies from as short as a few months to an as yet indeterminate number of years, with a median of nearly 10 years.[7] However, the duration or latency period to AIDS in persons with hemophilia may differ from that of other AIDS risk groups.[8–10] The most important factor in disease progression is time from primary infection, but factors as diverse as geographic location[11] and HLA (human lymphocyte antigen) type[12] may play a role. In this study, the HIV seroprevalence and incidence of AIDS in hemophilic persons in California were estimated to assess associations with age, hemophilia type, and clotting factor level.

Methods

Five federally funded California hemophilia centers (FFC) provide comprehensive care to approximately 65 percent of the persons with hemophilia A and B in California[13] and report activities annually to the federally funded agency. An additional 25 percent of the patients receive care through eight other centers (SSC) and report voluntarily. It is estimated that the remaining 10 percent of the patients receive care through health maintenance programs, the military, or private practitioners. As part of their 1987 annual report, both groups of centers were asked to include additional information for all hemophilia patients on HIV antibody test result (positive, negative, or not tested); age group of patient (<5 years, 6 to 12 years, 13 to 16 years, 17 to 20 years, or above 20 years); level of clotting factor deficiency (<5 percent or 5 percent–40 percent); and type of hemophilia (Factor VIII or Factor IX deficiency). The HIV antibody testing of hemophilia persons is voluntary, with encouragement to all patients. Mild hemophilia persons were usually followed less actively at the centers, and centers were less aggressive about testing younger children since they were much less likely to be infected because viral-activated products had usually been used.

For this study, AIDS cases were those reported to CDC as of 9/2/88 by any center, physician, and local department of health within California, that were diagnosed between 1/1/85 and 12/31/87, and were verified by the reporting official to have received their care from one of the 13 reporting centers. The inclusive time period of 1985–87 was used because use of viral inactivated products was instituted in 1984, and seroconversion had virtually ceased by 1985.[14] Thus the number of seropositive persons was stable for this period and the cumulative incidence of AIDS is the number of reported AIDS cases divided by the number of known HIV seropositive patients during the inclusive three-year period of 1985–87. The age group of AIDS cases is based on age as of 1987, the year of the annual report. Similar analyses were repeated when California hemophilia-associated AIDS cases included those not reported by FFCs or SSCs.

Logistic regression analysis was used for both the univariate and multivariate analyses to calculate odds ratios (OR) and 95 percent confidence intervals (CI).[15,16] Univariate analyses were performed on each of the four categorical variables (age group, hemophilia type, clotting factor level, and treatment center type). Next, for HIV-tested patients, a multivariate analysis was used to analyze the four variables in a full model to adjust for the effects of potential confound-

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ing variables. Logistic regression analysis was also used to compare between the HIV-positive patients in relation to outcome of AIDS. For this analysis, the three categorical variables were age group (≤20 and ≥21 years of age), hemophilia type, and clotting factor level.

Results

Most patients (72.0 percent) were reported from the five major centers which also tested proportionally more patients (Table 1). Clotting factor levels <5 percent and age were also associated with testing, but factor deficiency was not associated.

Of the 860 tested patients, 537 (62.4 percent) were HIV-antibody-positive and 323 (37.6 percent) were antibody-negative. The odds ratio of HIV seropositivity increased with age group (Table 2). The odds of HIV seropositivity may have stabilized beginning with the 13–16-year age group: ORs of the 13–16 and 17–20 year-old age groups did not differ from those 21 years of age or older (OR = 1.3, CI = [0.7–2.4]; OR = 1.5, CI = [0.9–2.7], respectively). Factor VIII deficient patients were more likely to be HIV positive than factor IX deficient patients, and patients with clotting factor levels <5 percent were more likely to be HIV positive than patients with clotting factor levels ≥5 percent. Using a full logistic model, there were no differences in HIV positive rates in patients from the two groups of centers; the differences in HIV positive rates by age, hemophilia type, and clotting level remained.

TABLE 1—HIV Testing Status of Hemophilia Patients by Patient Characteristics

Characteristics	Number of Patients	Percent Tested	OR	(95% CI*)
Age Group (year)				
≤5	155	45.8	1.0**	
6–12	222	57.2	1.6	(1.0, 2.4)
13–16	98	57.1	1.6	(0.9, 2.6)
17–20	127	62.2	1.9	(1.2, 3.1)
≥21	836	63.0	2.0	(1.4, 2.9)
Factor Deficiency				
IX	306	55.2	1.0**	
VIII	1132	61.0	1.3	(1.0, 1.6)
Clotting Factor Level				
≥5%	404	44.8	1.0**	
<5%	1034	65.7	2.4	(1.9, 3.0)
Treatment Center Type				
SSC	402	49.8	1.0**	
FFC	1036	63.7	1.8	(1.4, 2.2)

*95% confidence interval.
**Reference group.

Sixty-two patients from the hemophilia reporting centers were reported with an AIDS diagnosis made in 1985–87 in California. This represented 11.6 percent of known seropositive patients in the centers. Age was the only factor associated with AIDS diagnosis (Table 3). Eight of 167 of those less than 21 years old developed AIDS, six persons 6–12 and 2 persons 17–20. Distribution of the date of diagnosis for the eight persons <21 years of age was similar to that of the older population. However, a difference in the rate of AIDS was seen between age groups. This distribution was bimodal with the 6–12-year-old group showing higher rate (10.0 percent) than those in the 13–16 and 17–20 age groups (0.0 percent and 3.2 percent, respectively), although not as high as the ≥21 age group. Results similar to those described above were also seen in the analysis of all 72 patients who were reported by the centers as developing AIDS through 1987.

Discussion

Most persons with hemophilia became infected with HIV in 1981 to 1984.[2,3] After 1984, viral-attenuated clotting factor concentrates became widely used resulting in only rare seroconversions in uninfected persons.[17] Therefore, a low seroprevalence in hemophilic children under 6 years of age and an increasingly higher prevalence in older persons with hemophilia was to be expected.[18] In addition, we found this association to remain when taking into account the hemophilia type, clotting factor level, and treatment center type. We also found that older persons with hemophilia were at a higher risk of AIDS, as was shown in a recent study.[19] Although patients between 6 and 12 years had a higher rate than those of other age groups <21 years, there was a small number of cases in each of those age groups.

Why patients followed by one set of centers were more likely to be tested than patients from the other set is not

TABLE 2—HIV Serologic Status of Patients by Patient Characteristics

Characteristics	No.	Percent HIV+	Univariate OR	Univariate (95% CI*)	Multivariate OR	Multivariate (95% CI*)
Age Group (year)						
≤ 5	71	4.2	1.0**		1.0**	
6–12	127	47.2	20.3	(6.1, 67.9)	22.2	(6.6, 75.0)
13–16	56	75.0	68.0	(18.4, 250.7)	91.2	(23.9, 347.6)
17–20	79	78.5	82.7	(23.1, 295.8)	152.0	(40.8, 566.2)
≥21	527	70.2	53.4	(16.6, 172.3)	103.9	(31.6, 340.9)
Factor Deficiency						
IX	169	52.1	1.0**		1.0**	
VIII	691	65.0	1.7	(1.2, 2.4)	2.0	(1.3, 3.0)
Clotting Factor Level						
≥5%	181	30.4	1.0**		1.0**	
<5%	679	71.0	5.6	(3.9, 8.0)	9.7	(6.5, 14.6)
Treatment Center Type						
FFC	660	60.3	1.0**		1.0**	
SSC	200	69.5	1.5	(1.1, 2.1)	1.1	(0.7, 1.7)

*95% confidence interval.
**Reference group.

TABLE 3—AIDS Status of Hemophilia Patients by Patient Characteristics

Characteristics	Number HIV +	Percent AIDS	OR	(95% CI*)
Age Group (year)				
≤20	167	4.8	1.0**	
≥21	370	14.6	3.4	(1.6, 7.3)
Factor Deficiency				
IX	88	9.1	1.0**	
VIII	449	12.0	0.7	(0.3, 1.6)
Clotting Factor Level				
≥5%	55	10.9	1.0**	
<5%	482	11.6	0.9	(0.4, 2.3)

*95% confidence interval.
**Reference group.

known. The eight hemophilia programs with a lower testing rate were usually staffed by health care workers providing care to patients with a variety of hematologic and oncologic diseases, whereas the five centers with a higher testing rate were more hemophilia focused.[13]

In this retrospective study, the denominator of HIV seropositive persons shifted over part of this period, with the prevalence of infection increasing during 1981 through 1984. Although this might affect our results, the substantial differences observed suggest that these estimates, which cannot be better specified, are not likely to account for the observed differences. Also, as expected, the tested group consisted of patients that were older and/or with severe hemophilia, both of these factors would tend to bias the associations with HIV seropositivity toward nonsignificance. That is, the patients not tested were younger and probably at a lower risk of infection; therefore, if tested, the seropositivity rate of younger patients would be lower and the observed difference detected in age may be even greater than noted by our estimates. The analysis of the rate of AIDS was performed using AIDS cases from the defined centers as the numerator and patients with a positive HIV antibody status determined from those tested as the denominator. Thus, the age bias in HIV testing would only tend to underestimate the denominator for younger persons. The observed age difference of the rate of AIDS may thus be more dramatic than estimated herein.

The reason for the discrepancy in AIDS prevalence between age groups may be that younger hemophilic patients received less clotting factor than older hemophilic patients, that is, they were exposed to the HIV virus later than their older counterparts and have an "earlier" phase of the infection. Although it cannot be proved or disproved by this study, because specific dates of seroconversion are not available on these patients, this hypothesis is unlikely. The critical variable in hemophilia treatment may be the frequency of infusions and extent of exposure to different clotting factor concentrate lots, not age. Persons bleeding more frequently will be exposed to more lots of commercially prepared clotting factor concentrates and therefore be more likely to receive concentrates from a contaminated lot. Young, active hemophilic boys ages 3 or 4 years through adolescence are the most physically active and consequently have frequent hemorrhages requiring infusion therapy.[20] However, the rate of AIDS would be expected to be high through adolescence, not just for the 6- to 12-year olds age group. While exceptions certainly occur, the size of the currently reported population would result in a relatively homogeneous group. Further, the epidemiologic curves of AIDS diagnosis over time for those <21 and ≥21 years are similar. Consequently, reasons for the differences in the biological response to HIV infection between the two broad age groups should be sought among physiologic mechanisms. In addition, if age differences were representative of the true differences in the population, and age is an important cofactor in the development of AIDS, the important scientific and public health implications merit further investigation.

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The Infrastructure of Religious Communities: A Neglected Resource for Care of People with AIDS

Earl E. Shelp, PhD, Edwin R. DuBose, PhD, and Ronald H. Sunderland, EdD

Abstract: The AIDS Interfaith Council of Houston, sponsored by the Foundation for Interfaith Research and Ministry, recruits, trains, and coordinates volunteers for home-based care for adults and children with AIDS (acquired immunodeficiency syndrome). The program provides compassionate, non-judgmental care for the sick and respite support for the primary care provider. Care is provided by highly motivated, trained volunteers. The respite care team model also represents a support system to complement medical management and other health care services for people with AIDS. With the expanding number of cases and the growing preference for clients to remain at home, such a model will become increasingly important as people continue to live longer with AIDS. (*Am J Public Health* 1990; 80:970–972.)

Introduction

With the advent of acquired immunodeficiency syndrome (AIDS), biomedical scientists, physicians, providers of social services, and social communities face a complex and serious challenge. Progress has been made in understanding the etiologic virus—human immunodeficiency virus (HIV)—its destructive effect on a human host, and palliative therapies for HIV infection. Improved medical management of associated illnesses has been developed. Given the psychosocial, emotional, medical, and economic burdens related to HIV disease, the importance of supportive services is clear.[1,2] Traditionally, in times of illness, religious communities have been an effective support system for individuals, their families, and friends. In the AIDS epidemic, these communities are challenged to respond to the sick and suffering with compassionate, non-judgmental support.

The Houston (Texas) Standard Metropolitan Statistical Area presently ranks fourth among cities in the United States for cumulative reported cases of AIDS.[3] As of January 2, 1990, the cumulative case report for people diagnosed with AIDS was 3,558, of whom 1,177 are living.* It is projected that the cumulative number of reported AIDS patients in Houston alive at the end of 1992 will range from 4,573 to 5,740.**

Relatives and friends of people with AIDS face the pressures of caring for people who are seriously ill as well as dealing with the economic and psychosocial concerns that accompany AIDS. Outpatient and home-based care are important for both economic and emotional reasons.[4,5] Along with the deterioration of their health and the fear of abandonment, patients and caretakers must cope with loss of employment and insurance. Also, an increasing number of people with AIDS have no insurance at the beginning of their illness. If the rate of progression and the preferences of people with AIDS for outpatient and in-home terminal care remain constant, the need for volunteers to provide in-home respite and supportive care will grow. In this article we describe an innovative service project which addresses the needs of people living with AIDS. A detailed description of the program, including the content and process of the educational program for the volunteers, is available from the authors.

The AIDS Interfaith Council

The AIDS Interfaith Council of Houston is an association of clergy and laity which provides educational and service programs in response to the expanding AIDS epidemic. A program sponsored by the Foundation for Interfaith Research and Ministry, the Council was created in January 1986 to offer congregation-based supportive care to people with AIDS and their loved ones. Over 650 volunteers organized in congregation-based teams offer friendship and respite from some of the time consuming tasks involved in caring for a person who has become seriously ill. The paid staff of the Foundation, which coordinates the activities of the Council, presently consists of 10 people who are responsible for administrative, supervisory, educational, training, service, resource development, fund raising, and counseling duties.

The AIDS Interfaith Council appears to be the oldest, largest, and most active congregation-based supportive program in the United States. Surgeon General C. Everett Koop noted during a speech to the Council in May 1988, "I think that what you've done here is tremendous . . . you're way ahead of the rest of the country. If it would be possible to take what you've done to other parts of the country, we would see networks such as you have here spring up all over the land."[6]

Program Description

The respite care teams are the heart of the program. Teams of volunteers from individual congregations are recruited and trained to provide social support, physical care, emotional support, and spiritual care to dependent, home-based patients and their loved ones. At the end of 1989, 28 Houston area churches and synagogues each provide a team of volunteers sponsored, trained, and coordinated by the AIDS Interfaith Council. No fees are charged for any services of the Council or the care teams.

Volunteers are recruited during educational programs in congregations at which facts regarding AIDS and risk reduction are given. Recruiters remind people who attend that they have a religiously grounded moral obligation to care for sick and dependent people regardless of the affliction or the means by which the dependency developed.[7] Education becomes an essential prerequisite to the recruitment of volunteer teams, since it is during these sessions that AIDS-related myths and fears are addressed.

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*Houston Department of Health and Human Services, Bureau of HIV Prevention Update, January 2, 1990.

**Harris County (Texas) Department of Health: The AIDS/HIV Forecast for Houston: A Report to the Long Range Planning Committee of the Greater Houston AIDS Alliance, November 1989.

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Once recruited, teams of at least 14 people receive three types of training for their services to people living with AIDS. One component focuses on organizational and operational matters. A second component is on the development of listening and care skills, including how to provide emotional support to sick and dying people. A third component deals with basic nursing and hospice care of people with AIDS. The three components require seven hours of orientation and training. The team chooses a team leader who assumes overall administrative responsibilities for scheduling, communication, and record-keeping. The teams schedule monthly meetings for discussion of patient progress, continuing education, peer support, and social support.

Teams then are assigned patients who are either self-referred or have been referred to the Council by physicians, social workers, discharge planners, and other service agencies. Ordinarily, paired team members meet with each patient at a frequency per week agreed upon by the client and caretaker and consistent with the person's needs. Visits usually last between three and four hours. As a client or caretaker desires, e.g., during a crisis period, additional team members are assigned. By the time a client progresses to a terminal state, services typically are provided seven times a week. If a client enters hospital for acute or terminal care, the team maintains contact until discharge to home or death. Team members know, as they accept responsibility for the care of a new client, that they may expect to share in his or her death.

This commitment enables the person with AIDS to retain a degree of autonomy and independence that otherwise would be difficult to maintain. Depending upon the person's needs and desires, the teams provide social and emotional support, accompany the client on shopping activities, and provide housekeeping assistance, transportation, basic nursing care, and other appropriate "hands-on" care. Care team members encourage clients to set their own agendas, thereby reinforcing their autonomy. Their readiness to help a client sift through options and explore possible actions, to "listen" as the person works through his or her emotional concerns, together with offers of practical aid, affirm the client's dignity.[8] Pastoral care and sacramental ministries are available upon request by the client. No spiritual or moral agenda is forwarded by any team member.

The focus of care and support is not restricted to the person with AIDS. Other people in the home (roommate, lover, family member) often welcome the respite and emotional support provided by team members. Primary care providers are supplemented, not replaced, by these teams. Strong bonds tend to be established over time. Survivors of deceased loved ones often become involved in this program in gratitude for the care received and to continue their commitment to people touched by AIDS.

We have learned that people in the advanced stages of HIV infection have in-home needs that tend to be too great for one or two people to provide. The availability of 14–20 people to supplement or to provide primary supportive care tends not only to improve the quality of life for a dependent client, but also appears to be a means for caring for people at home rather than in a higher cost institution. The presence of volunteers also allows people who so desire to die at home. Without this sort of support, many indigent and non-indigent people would spend their last weeks in hospital or nursing home (if the nursing home would accept a person with AIDS) against their wishes and at a higher expense to them or the community.

The nature of the activities and context in which teams are involved creates stress, grief, and bereavement which must be addressed to maintain the volunteers' emotional well-being and the quality of services. Supervision of team activities and group therapy for teams, therefore, are crucial. Each team meets with supervisory/therapeutic personnel (MSW or doctoral level professionals) approximately every 4–8 weeks. At these meetings, individual and team concerns are addressed. Guidance and intervention by supervisory or therapeutic personnel occurs as indicated. The volunteer commitment and congregational endorsement of the teams, plus careful supervision, appear to minimize volunteer turnover.

TABLE 1—Trends in Volunteer Services by Client Breakdown, AIDS Interfaith Council of Houston

	1986	1987	1988	1989	Total
Number of Teams (cumulative per year)	6	11	21	28	28
Clients (per year)					
New	66	100	147	173	486
Clients receiving team service	60	75	119	172	426
(Percentage increase)	—	(25)	(58)	(44)	—
Clients receiving financial aid or pastoral care	6	25	28	1	60
Terminated (death, lost to system)	49	92	126	134	401
Year end census	17	25	46	85	—
Cumulative (year end census plus new)	66	117	172	219	—
Average hours per client/per year	*	*	168.6	200.9	
Houston-Harris County AIDS Cases (new per year)	596	756**	935**	1127**	
(Percentage increase)	—	(26)	(23)	(20)	

*No record of client contact hours was kept in 1986 or 1987.

**Estimated number of reported new cases per year, Harris County Health Department, December, 1988.

Activity Statistics

The program has served 16 percent of the cumulative AIDS cases in the Houston SMSA since the Council began in 1986 (486 of 3,005 cases diagnosed). There has been an increase in the number of teams in each year of the program. The number of people with AIDS who have made use of the care teams also has grown every year since 1986 (Table 1). The growth in the provision of volunteer services clearly outdistances the rate of growth of the epidemic in Houston. The rate of increase in clients doubles the rate of increase of new diagnoses in Houston in 1988 and 1989 (Table 1). Over 73,000 contact hours of service were given in 1988–89. At a value of $8/hour for comparable home attendant care,*** volunteers provided $584,000 worth of services during the two years.

Discussion

The value of the program is clear. The program seems to be a logistically efficient means of providing home-based care for people touched by AIDS. By recruiting volunteers from religious communities, the program draws upon a ready pool of motivated people already oriented to visiting the sick. The team model provides peer and supervisory personnel to resolve volunteer and client problems.

The adult care team model has the capacity for replication in any neighborhood and is being duplicated in other cities (e.g., New Orleans, Baton Rouge, San Antonio, Little Rock, Albu-

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***According to the Visiting Nurses' Association, the value of home attendant care in the Houston area is $8/hour.

querque, and Dallas-Ft. Worth).† Finally, given the widespread misunderstanding of HIV/AIDS in the general public, the program encourages a greater degree of knowledge and compassion for affected people. As more congregations become involved, a discrediting of stereotypes about people with AIDS occurs. The work of the Care Teams becomes a form of community education both within the general community about HIV/AIDS and for at-risk people about the perceived indifference to their condition by the general population.

The care team model has encountered several problems. First, since the medical knowledge and treatment of AIDS changes rapidly, there is a need for continuing education of volunteers. Volunteers are open to continuing education only if the programs are conducted in the setting of the team's regular monthly meeting. Traveling to 28 locations for continuing education sessions makes for inefficient use of staff time, but elicits a higher response from volunteers. Second, nearly all clients are followed to death. As volunteers become increasingly involved in the lives of their clients, the issues of grief and bereavement are very real. Therefore, both individual and group supervision of the volunteers are important aspects of the program. Therapy is made available at no charge to the volunteers who request it.

We have found if difficult to develop a volunteer profile. It is our impression that the teams generally reflect the demographic profile of their congregations. However, our experience has been that volunteers would interpret questions regarding their personal lives as intrusive and irrelevant to their service. Their priority clearly is patient care, no participation in record-keeping.

The 1989 rate of increase in new Council clients moderates an upward trend but continues to outpace the increase in new diagnoses. The clients on average are receiving care for a longer period of time, thus reducing the number of new clients a team can serve during the year (Table 1). The number of referrals and requests for service increased in 1989. All requests could not be met, however, because clients resided in areas in which presently there is little or no team coverage.

Therefore, a fourth area of concern is the resistance of congregation leadership to an identification with AIDS and those people affected by it. Resistance to educational programs among some religious groups ranges from specific concerns about condom use, drug use, and sexuality in general. Some religious leaders seem to fear that discussion of HIV/AIDS is equivalent to promoting of high-risk behaviors. The Council maintains that objective information about HIV/AIDS is a primary means for containing the disease. Combined with a sensitive concern for the moral and theological positions of the various communities, knowledge about HIV disease lessens personal anxieties and fears and helps build community support.

Fifth, as in the rest of the country, there is an increasing number of IVDUs (intravenous drug users) with AIDS in Houston. Studies show that minority populations are disproportionately represented in the AIDS epidemic.[9,10] This development highlights the need of involving Black and Hispanic churches in the Council's work. There has been some recent success in recruiting teams from several Black churches. Outreach to Hispanic groups has become a priority. Nevertheless, given the large number of Black and Hispanic congregations in Houston, response has been disappointing. Cultural factors such as the stigma of homosexuality play a role, as does the reluctance to link AIDS closely to minority communities. Until religious leadership in all areas of Houston recognize the need to respond to the AIDS crisis, the availability of congregation-based care team services to minorities will be limited.

Finally, with the increasing rate of HIV infection among female IVDUs or the sexual partners of IVDUs, the number of pediatric AIDS cases is increasing in Houston. Presently, the care teams are expanding their services to include children and their families. The needs of families with HIV seropositive children are different than those of adults.[11,12] Special features associated with these needs include infection in one or both parents, perhaps a single parent family setting, as well as the possible presence of siblings. Building upon experience gained in the last four years, the Care Team model has been revised to provide services to these families. Beginning in July 1989, the Foundation committed its resources to recruiting, training, and supervising Pediatric Care Teams. A four-hour training program oriented toward the features of pediatric AIDS was added to the adult training component. Eight of the 28 care teams are working with children who have AIDS. Since July 1989, these volunteers have extended care to 15 children, of which two have died.

The problems and concerns of men, women, and children living with AIDS are many and severe. As the numbers of people with HIV disease increase, the demand for medical and support services will continue to grow. One resource that can be developed and utilized to ease the psychosocial burdens of people with AIDS is the congregation-based care team model.

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†Based upon the work of the AIDS Interfaith Council's Adult AIDS Care Team model, the staff of the Foundation participated in writing the proposal for the creation of a regional interfaith project including the cities of New Orleans, Baton Rouge, San Antonio, Little Rock, and Albuquerque. This proposal was funded by the Robert Wood Johnson Foundation in 1988. Dallas-Ft. Worth has followed a similar course with funding from Robert Wood Johnson Foundation.

Maintenance of Safer Sexual Behaviors and Predictors of Risky Sex: The San Francisco Men's Health Study

MARIA L. EKSTRAND, PHD, AND THOMAS J. COATES, PHD

Abstract: This paper describes the sexual behavior changes made by 686 gay and bisexual men in San Francisco between 1984 and 1988, focusing on the individual maintenance of this behavior change over time. There were drastic reductions in insertive and receptive unprotective anal intercourse over time and the vast majority of subjects were able to maintain these changes for at least 12 months prior to the last interview. A total of 12 percent of participants admitted to relapsing to unprotected receptive anal intercourse following initial behavior change; 10 percent reported engaging in unprotected receptive anal sex during every year of the study period. Men were more likely to practice unprotected anal intercourse in 1988 if at baseline they were younger, practiced unprotected anal intercourse, reported more sex partners, did not have a close friend or lover with AIDS, and engaged in fewer other health-related behaviors. (*Am J Public Health* 1990; 80:973–977.)

Introduction

This study seeks to document the stability of change and psychosocial predictors of unprotected anal intercourse in a probability sample of San Francisco gay and bisexual men. Gay men account for 95.7 percent of all AIDS (acquired immunodeficiency syndrome) cases in San Francisco to date[1] and 68 percent of the cases in the United States to date.[2] San Francisco gay and bisexual men have been particularly hard hit by this epidemic with infection rates estimated at 52 percent.[3]

Earlier studies[3–5, *, **] have documented drastic sexual behavior changes in volunteer samples of gay and bisexual men in San Francisco. Although these findings are encouraging, it is crucial that the changes are maintained over time. There have been few studies examining the long term stability of this behavior change. Joseph, Montgomery, Kessler, *et al*,[***] reported that between 25 and 35 percent of their sample of Chicago gay men resumed high-risk behavior at least once following initial risk reduction. In Boston, 13 percent of the gay men who reported practicing safe sex in year one relapsed during the following year.[†] The present study examines both the prevalence and decline of high-risk behavior among all gay and bisexual subjects as well as the stability of this change and the relation between high-risk behavior and demographic and psychosocial variables, HIV (human immunodeficiency virus) antibody status, HIV-related symptoms, and other health-related behaviors.

Methods

Subjects

The San Francisco Men's Health Study is a prospective study of single, predominately White, well-educated males between the ages of 25 and 54 recruited by multistage probability sampling from the six kilometer square area in San Francisco with the highest cumulative incidence of AIDS in 1984. Sampling methods, as well as statistical, and data collection procedures have been described previously.[3,5,6]

The analyses in the present study include data on 686 gay and bisexual men who participated in the first year (July 1984–June 1985) of data collection, 633 who participated in the second year (July 1985–June 1986), 627 from year three (July 1986–June 1987), and 592 from year four (July 1987–June 1988). At least 57 subjects died between July 1984 and June 1988 and an additional 25 subjects had died from 1988 to 1989.

Demographic subject characteristics for this subsample, obtained in July 1984, show that this area is populated mostly by White, employed, and well-educated gay males.

Analysis of Attrition Bias

We compared those subjects who remained in the study to those who dropped out between 1984 and 1988. The scores of these two groups on all predictor and outcome variables in year one did not differ appreciably with regard to sexual behaviors (Table 1). Dropout subjects were more likely to be HIV positive in year one, and to report HIV-related symptoms at that time; they were more depressed, drank less alcohol, and thought of themselves as gay at an earlier age than subjects who remained in the study. These differences probably reflect the differing percentages of HIV positive subjects in the two groups.

Measures

Sexual Behavior—Self-report data on high-risk sexual behavior were obtained eight times from July 1984 to June 1988. Subjects were asked whether they had engaged in any sexual activity during the previous six months. Those who answered "yes" were then asked whether they had engaged in any of 22 specific behaviors. For each of these activities, the subjects were asked to report the number of partners with whom they had engaged in that behavior since the last clinic

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TABLE 1—Comparison of Panel Members and Dropout Subjects at Year One (1984–85)

Variables	Stayed (n = 592)	Dropped (n = 94)	(95% CI of differences)
		1. proportions	
Any unprotected anal intercourse	.78	.76	(−.10,.06)
Oral sex	.95	.94	(−.06,.04)
Oral-anal contact	.37	.46	(−.03,.19)
Anonymous partners	.50	.54	(−.07,.15)
Multiple partners	.82	.74	(−.16,.02)
Smoked regularly	.37	.47	(−.01,.21)
Antibody positive	.48	.72	(.14,.34)
HIV-related symptoms	.40	.58	(.07,.29)
Friend, lover with AIDS	.40	.50	(−.02,.20)
		2. means	
Age (years)	36.5	36.5	(−1.5,1.4)
Age (years) at which first thought of self as gay	18.9	17.4	(−3.0,−.1)
Age (years) at which first socialized as gay	21.4	20.6	(−1.7,.2)
Alcohol consumption (mean)	4.3	3.8	(−.8,−.1)
Loneliness (mean)	4.3	4.0	(−.1,.7)
Depression (mean)	8.7	11.1	(.5,4.3)
Amount of social support (mean)	81.2	89.9	(−1.0,.6)
Social support satisfaction (mean)	32.1	32.3	(−7.4,24.6)

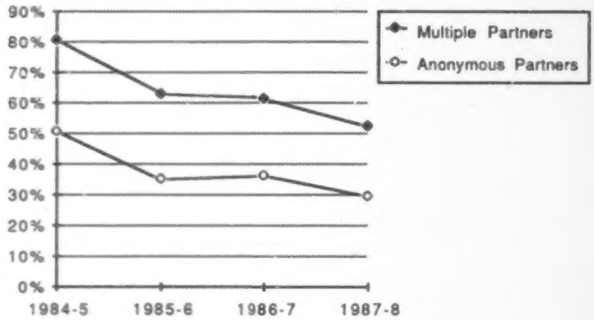

FIGURE 2—Percent Men Who Reported Having Sex with Multiple and Anonymous Partners Each Year

visit. Although unprotected insertive and receptive anal intercourse and multiple sexual partners are the only firmly established major risk factors for seroconversion in male-to-male relationships,[7] we also examined the prevalence of anal-oral contact, genital-oral contact, fist-anal contact, and whether the respondent had engaged in sex with anonymous partners. To facilitate presentation, we combined these eight six-month segments into four one-year intervals. Since all of the sexual behaviors have been dichotomized, an affirmative response during either six-month segment in a given year resulted in an individual being classified as having engaged in the behavior during that year.

To examine correlates of risky sex, two multiple logistic analyses were conducted, predicting unprotected receptive and insertive anal intercourse in waves two (January to June 1985) and eight (January to June 1988). The predictor variables in these analyses (Tables 2 and 3) also included items developed for the psychosocial component of the project and were administered to the subjects in wave 2 (January to June 1985); they are defined in detail in the Appendix.

Procedure

We examined yearly prevalence rates of sexual behaviors for the entire gay and bisexual sample. Group changes in sexual behaviors from 1984 to 1988 were then analyzed using McNemar tests.[8]

We also examined fluctuations in individual behavior patterns. In order to do this, the study period was divided into four 12-month segments consisting of: 1) July 1984 to July 1985; 2) July 1985 to July 1986; 3) July 1986 to July 1987; and 4) July 1987 to July 1988. A subject was considered "high risk" for a given period if he reported engaging in any unprotected receptive or insertive anal intercourse with or without ejaculation during that time. This yielded 16 behavior patterns which were combined into four groups; stable low risk, stable high risk, change from high to low risk, and relapse.

The relation between the predictor variables and unprotected anal sex was examined using multiple logistic regression.[9] A dichotomous score was created classifying subjects as high risk if they reported having engaged in either insertive or receptive unprotected anal intercourse during January to June 1985 and 1988.

Results

Behavior Change

Figures 1, 2, and 3 present data showing the percent of men who reported engaging in each of the sexual behaviors in years one through four (i.e., 1984–5, 1985–6, 1986–7, and 1987–8). The most dramatic changes have occurred in unprotected insertive (37 percent to 2 percent) and receptive (34 percent to 4 percent) anal intercourse with ejaculation. Significant changes were also reported in insertive and

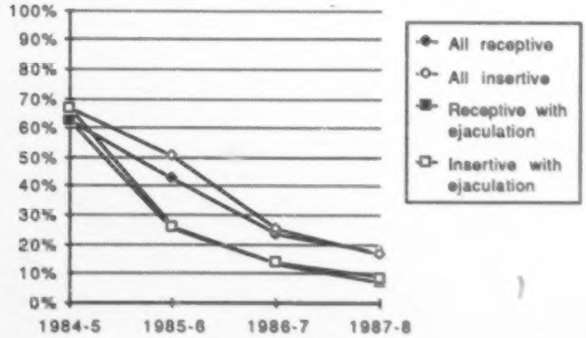

FIGURE 1—Percent Men Who Reported Engaging in Unprotected Anal Intercourse Each Year

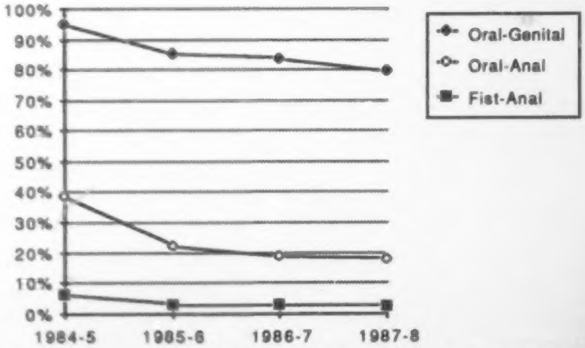

FIGURE 3—Percent Men Who Reported Engaging in Oral-genital, Oral-anal, and Fist-anal Sex Each Year

TABLE 2—Cross-sectional Predictors of Unprotected Anal Intercourse in 1985

Predictors	Adjusted Odds Ratio	(95% CI)
Age (20 year difference)	0.6	(0.5,0.8)
Age at which first thought of self as gay	1.0	(0.9,1.2)
Age at which first socialized as gay	1.1	(0.8,1.3)
Number of sex partners	1.4	(1.2,1.6)
Antibody status (positive)	1.3	(1.1,1.5)
HIV-related symptoms	1.1	(0.9,1.3)
Smoking	1.1	(0.9,1.3)
Alcohol consumption	1.3	(1.1,1.6)
Friends, lover with AIDS	0.9	(0.8,1.1)
Loneliness	1.0	(0.9,1.1)
Amount of social support	1.0	(1.0,1.0)
Social support satisfaction	1.0	(0.9,1.2)
Depression	0.9	(0.8,1.0)

receptive anal practices with and without ejaculation, which decreased from 42 percent and 63 percent to 17 and 17 percent respectively. All behaviors changed significantly from year one to year two. After June 1986, most behavior changes leveled off. Unprotected insertive and receptive anal intercourse and insertive oral-genital contact continued to decrease significantly from 1985–6 to 1986–7. The percent of subjects reporting unprotected insertive and receptive anal sex, insertive and receptive oral-genital contact, sex with anonymous partners, and multiple sexual partners continued to decline until 1987–8.

Maintenance of Behavior Change

Behaviors were remarkably stable: 25 percent and 31 percent of the subjects were classified as stable low risk, and an additional 50 percent and 47 percent fell into the change to low risk category. Only 16 percent and 12 percent of the subjects admitted to relapsing to unprotected insertive and receptive anal sex, respectively, while an additional 10 percent were stable high risk.

Younger men were more likely to engage in unprotected anal intercourse than older men in the sample in both 1985 and 1988. Subjects who reported in 1985 that they had friends or lovers with AIDS were less likely to engage in unprotected anal sex in 1988 than were men who did not have this experience (Table 3).

TABLE 3—Longitudinal Predictors of Unprotected Anal Intercourse in 1988

Predictors	Adjusted Odds Ratio	(95% CI)
Age (20 year difference)	0.6	(0.3,0.9)
Baseline sexual behavior	3.4	(2.1,5.4)
Age at which first thought of self as gay	1.0	(0.8,1.4)
Age at which first socialized as gay	1.0	(0.7,1.6)
Number of sex partners	1.2	(1.1,1.4)
HIV positive, knowing results	0.7	(0.5,1.1)
HIV negative, knowing results	0.9	(0.6,1.3)
HIV positive, not knowing results	0.7	(0.4,1.1)
HIV-related symptoms	0.9	(0.7,1.2)
Smoking	1.3	(1.0,1.6)
Alcohol	0.8	(0.6,1.2)
Friend, lover with AIDS	0.8	(0.6,1.0)
Loneliness	1.1	(0.8,1.2)
Amount of social support	1.0	(1.0,1.0)
Social support satisfaction	1.1	(0.9,1.4)
Depression	1.1	(0.9,1.3)

See appendix for a description of measures

Men who reported engaging in unprotected anal intercourse in 1985 were likely to report doing so in 1988 than were men who had been practicing safer sex only in 1985.

Participants who were HIV positive in 1985 were more likely to engage in unprotected anal sex at that time. However, knowledge of HIV antibody status in 1987 did not predict sexual behavior in 1988. The presence of HIV-related symptoms did not predict report of high-risk behavior.

Men who reported a greater number of partners in 1985 were far more likely to practice unprotected anal sex in 1988 than were men who had been practicing safer sex only in 1985. Subjects who reported consuming a greater volume of alcohol were more likely to report engaging in high-risk sexual behavior than those who reported less alcohol consumption. This relation held for the cross-sectional analysis in 1985, but did not predict risk behavior longitudinally. Subjects who reported smoking regularly in 1985 were somewhat more likely to engage in unprotected anal sex in 1988.

Men who reported greater levels of depression in 1985 were less likely to report having engaged in unprotected anal sex in that year than subjects who reported fewer depressive symptoms. Participants who reported having a large number of people on whom they could rely for social support were less likely to report practicing risky sex. Loneliness and satisfaction with social support were unrelated to sexual behaviors.

Discussion

The results on individual and group behavior change show that San Francisco gay men have greatly reduced their levels of almost all high-risk sexual behaviors from 1985 to 1988. The differences between all anal sex and anal sex with ejaculation may be due to a misconception that anal sex is "safe" as long as one withdraws before ejaculating.†† This fits with our finding that there has been very little change in oral sex practices, which is another behavior considered "safe" by many in the San Francisco gay community.

Approximately three-fourths of the subjects reported that they were in either the stable low or change to low categories. The data further show that occasional relapse is now more prevalent than stable high-risk practices in this community. Prevention efforts need to shift from focusing on the initial adoption of safe sex, to a relapse prevention format, emphasizing the long-term maintenance of safer sex.

Overall, these changes may represent the most profound behavior changes ever observed in the literature on health behavior change.[10] Studies on smoking cessation, alcohol abstinence and dieting show that it is extremely difficult to maintain healthy behaviors over time. The results on prevalence replicate findings from other San Francisco studies using volunteer populations,[11,12] thus providing a consistent picture of gay sexual behavior in San Francisco.

Although results from similar studies in other parts of the country also show a reduction in high-risk behavior in this population, the degree of stability of change observed in this study may be unique to this cohort or to San Francisco. Although this is good news, it is important to place it in context. It has been estimated that more than half of the mainstream gay community in San Francisco has been infected by HIV; any instance of risky sex with a partner of unknown serostatus thus carries an unacceptable risk. It is important to identify characteristics of relapsers and to obtain a better understanding of the reasons for relapse in order to design effective prevention programs focusing on both the acquisition and maintenance of safe sex in this population.

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††Ekstrand ML, Stall RD, Coates TJ, McKusick L, Morin S: Risky sex relapse: The next challenge for AIDS prevention: The AIDS Behavioral Research Project. Paper presented at the V International Conference on AIDS, Montreal, Canada, 1989.

The most consistent predictors of high-risk behavior included demographic and behavioral variables. Younger men were more likely to engage in unprotected anal sex and those who had friends or lovers with AIDS in 1985 were less likely to practice risky sex in 1988. These findings have been replicated both in other samples of gay and bisexual men[12–14] and among heterosexual men.††† The finding that younger gay men seem to be having more difficulty changing their behaviors could be due to a variety of factors, such as greater impulsivity, having less social support for safe sex practices, feeling uncomfortable obtaining or using condoms, perceptions of invulnerability, or having poor "safe sex negotiating skills." Results from a recent study of HIV risk-taking among young gay men[14] showed that those who practiced unprotected anal intercourse reported enjoying it more, perceiving it as less risky, and had poorer communication skills than those men who did not engage in this practice. The finding that men who practice risky sex report having less social support might be related to this issue, since it is possible that younger gay men may be less involved in the network of gay organizations than are older gay men in San Francisco. This may pose a challenge to future campaigns, since it would imply that the men who need to be targeted may be the hardest to reach.

Past sexual behavior appears to be a strong predictor of future sexual behavior. However, by targeting only those who report current unsafe behaviors we run the risk of missing many men at risk for future unsafe sex, since relapse is even more common than stable high-risk practices in this population. We may thus have to develop different targeting and intervention strategies for men who relapse than for men who have never adopted safer sexual practices.

The finding that antibody positive subjects were more likely to practice unprotected anal sex in 1985 may be due to a variety of factors. This was the year the HIV antibody test first became available and it is therefore possible that the subjects had not received the results of their antibody test when engaging in risky sexual practices. It is also possible that some of these people only engaged in unprotected anal sex with other seropositive partners. However, we have no data on partner serostatus. A recent study of the impact of antibody testing on sexual behaviors in this cohort showed that knowledge of being seropositive was associated with a lower prevalence of insertive anal intercourse in 1987.‡ No differences were found in the prevalence of receptive anal intercourse, suggesting that seropositive men perceive insertive practices as the most likely way of infecting others.‡ This distinction was not made in the present study and may explain why knowledge of serostatus failed to predict overall rates of unprotected anal intercourse. In addition, the Coates, *et al*, study followed subjects until 1987, while the present study examined behavior in 1988.

In summary, the data from this study suggest that we need to target younger gay men, and possibly men who are less involved in the social networks of the gay community. The prevailing norm needs to be that any unprotected anal sex, including occasional relapse, is risky and thus unacceptable.

APPENDIX

Selected Measures

- *HIV Status*

Although HIV status has been measured at each wave of this study, only subjects who have requested knowledge of their results have received them. In wave six (January to June 1987) we asked subjects whether they had received these results and, if so, from whom they had received them. The results showed that 33.1 percent and 31.4 percent knew that they were antibody positive and negative, respectively. An additional 17.3 percent and 18.1 percent were antibody positive and negative, but denied having received their test results. In our 1985 cross-sectional analyses, we were thus only able to use HIV status alone as a predictor of sexual behavior. In the longitudinal analyses, we combined actual HIV status with reported knowledge into three predictor variables (HIV positive, knowing results; HIV negative, knowing results; and HIV positive, not knowing results). For each of the three comparisons, the target group was compared to all other subjects.

- *HIV-Related Symptoms*

We used a clinical index that was developed in a previous study of this sample and which was found to predict HIV infection, diminished skin test reactivity, and reduction in Leu 3a T cells.[16] It includes self-report of the following symptoms: new rash, diarrhea, night sweats, weight loss, persistent fever, herpes, shingles, or bullous impetigo. In addition, it was noted whether the subjects had been diagnosed with oral hairy leukoplakia or oral candidiasis during their physical examination. A subject was considered to have HIV-related symptoms if he had any two or more of these symptoms or infections.

- *Health-Related Behaviors*

Quantity and frequency of alcohol consumption were measured during the interview by asking subjects both how often they had consumed an alcoholic drink during the past six months, and how many drinks they typically consumed on these occasions. Amount was scored on a 4-point scale ranging from "1 or 2 drinks" to "7 or more drinks," while frequency was measured on a 9-point scale, ranging from "every day" to "not at all." Information on amount and frequency of alcohol consumption was then combined into a single 7-point scale, where 1 = abstinent, 2 = occasional-light, 3 = occasional-heavy, 4 = infrequent-light, 5 = infrequent-heavy, 6 = frequent-light, and 7 = frequent-heavy consumption.

Cigarette smoking was assessed by asking subjects if they had been smoking during the past month (scored dichotomously).

- *Number of Sexual Partners*

Number of male sexual partners during the previous six months was used as a continuous measure to examine whether men who engage in unprotected anal sex are more likely to have fewer or more sex partners than men who do not engage in this practice.

- *Psychosocial Measures*

Loneliness was measured using the short form of the Revised UCLA Loneliness Scale.[17] This includes those four scale items, which, using optimal subset regression techniques, best predicted scores in the self-labeling loneliness index. (Chronbach's alpha = .75.)

Depression was assessed with the Center of Epidemiological Studies Depression Scale (CESD). The CESD[18] was developed for use in studies examining the epidemiology of depression in general populations. The scale has high reliability (.77–.92) and correlates highly with other measures of depression (.55–.74).

Social Support—The instrument contains 12 questions (four tangible support items, four emotional support items, and four informational support items). Structural support was expressed in the number of people providing each type of support. Perceived support is the tabulation of satisfaction ratings of that support. Satisfaction scores range from 3 (very satisfied) to 0 (not at all satisfied) for each type of support. The present study used an instrument partly derived from the Social Support Questionnaire by Sarason, *et al*,[19] chosen because of its high stability and internal consistency. The framework used to separate the items into distinct categories of emotional, tangible, and informational support comes from the research on the health-related functions of social support provided by Schaefer, Coyne, and Lazarus.[20]

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†††Guydish J, Coates T, Ekstrand M: Changes in AIDS-related high-risk behavior among heterosexual men. Presented at the IV International Conference on AIDS, Stockholm, Sweden, 1988.

‡Coates T, Ekstrand M, Kegeles S, Stall R: Knowledge of HIV antibody status, behavior change, and psychological distress in two cohorts of gay men in San Francisco. Manuscript under review.

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NIH Consensus Panel Issues Report on Sunlight and UVR

The National Institutes of Health convened a Consensus Development Conference on Sunlight, Ultraviolet Radiation, and the Skin last year, and has now issued a report containing conclusions and recommendations concerning the effects of sunlight and UVR on the skin. The report was prepared by a panel of experts who considered scientific evidence presented at the conference. A two-page summary of the document is also available. To obtain a free copy of the consensus statement on the effects of sunlight and UVR on the skin, contact:

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Longitudinal Predictors of Reductions in Unprotected Anal Intercourse among Gay Men in San Francisco: The AIDS Behavioral Research Project

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Abstract: Predictors of unprotected anal intercourse were examined among 508 gay men in San Francisco. The cohort was recruited in 1983–84 at which time 49.8 percent of non-monogamous men (N = 435) and 71.2 percent of monogamous men (N = 73) reported practicing unprotected anal intercourse. Only 12 percent of non-monogamous and 27.4 percent of monogamous men reported these practices in 1988. The non-monogamous men who practiced unprotected anal intercourse in 1984 were more likely to be younger, to report that unprotected anal intercourse was their favorite sexual activity, to be low in perceived efficacy to change sexual behavior, to report that friends were more likely to engage in high-risk behaviors, to have less knowledge of health guidelines, and to be less depressed at that time. Non-monogamous individuals who in 1984 reported that unprotected anal intercourse was their favorite sexual activity were more likely to practice that behavior in 1988. Those who knew their serostatus as positive were less likely to report unprotected anal intercourse in 1988. These data infer that in order to modify AIDS-related high-risk behaviors, community risk-reduction programs be differentially aimed at young persons so as to increase personal efficacy about risk reduction, challenge peer norms, promote antibody testing, and eroticize safer sexual activities. (*Am J Public Health* 1990; 80:978–983.)

Introduction

The incidence of new human immunodeficiency virus (HIV) infection, spread through male to male sexual contact, has recently been reported to be less than 1 percent per year in San Francisco.[1] This estimated low incidence rate is presumed to be due to behavior change rather than saturation of infection in the population. High-risk sexual behaviors likely to spread the virus have declined dramatically among gay men in many American urban settings.[2] Among the men in the San Francisco Men's Health Study, 44 percent reported unprotected anal intercourse receptive in 1985; this declined to 3 percent in 1988.[a] Rates of sexually transmitted diseases provide corroborative evidence of behavior change. In 1982, 13 percent of gay and bisexual men seroconverted, and there were 4,008 cases of gonococcal proctitis (GCP). In 1986, the HIV incidence among gay and bisexual men was 1 percent and there were 390 cases of GCP.[b]

Opinions vary regarding what influenced the massive changes in behavior observed in this population.[3–9] Some have drawn a close association between changes in behavior and the public education campaigns conducted in a coordinated fashion by agencies such as the San Francisco Health Department and the San Francisco AIDS Foundation.[3,4] Others have speculated that the observable presence of disease and death from HIV was responsible for individual modifications of behavior.[2,8,9] Few data have been presented to date about predictive associations between social or psychological variables and reductions in AIDS (acquired immunodeficiency syndrome) risk behaviors.[4,8] In earlier studies, we found that the number of sexual partners the previous month was positively correlated with use of sex to relieve tension and agreement that sexual freedom was linked to gay identity. Number of sexual partners was negatively correlated with awareness of the visual image of AIDS deterioration.[10] In a follow-up analysis predicting change from November 1983 to May 1984, four variables distinguished those retaining high numbers of sexual partners from those lowering the number: awareness of the visual image of AIDS deterioration, greater age, being in a primary relationship, and greater length of time since the first homosexual experience.[11]

Based on these preliminary findings, several measures were added to the 1984 and subsequent annual assessments to predict changes in high-risk behavior: measures of health belief adapted to HIV sexual behavioral risk reduction, standard measures of psychological distress, health-related variables, and measures of perceived norms for health risk activity. When the HIV antibody test was introduced, respondents were also asked whether they had been tested. Our intention was to establish a universe of possible psychological, social, and behavioral factors which may influence sexual behavioral risk for HIV transmission,[9] and to determine which of these factors predicted change over time.

Methods

Subjects and Procedures

Subjects for the AIDS Behavioral Research Project were recruited initially in 1983 and 1984 at bath houses and bars, and by advertising for individuals who were in committed relationships or who did not use bars or baths. A total of 754 men were enrolled in the sample in 1984, representing 51 percent of those approached to participate. Subjects were mailed a self-administered questionnaire each November, and asked to complete the questionnaire and return it by mail to the investigators. As of wave 5 of data collection (November 1988), 71 percent (n = 575) of the original cohort had responded to the survey. Another 8 percent (n = 61) are known to have died (either through the report of their friends or through matching in the California Death Registry). Data reported here are for 508 (67.4 percent of the original sample) men who returned every questionnaire between 1984 and 1988. Of the 508 men, 435 (57.7 percent) were non-monoga-

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Editor's Note: See also related paper p 963 this issue.

[a] Ekstrand M, Coates TJ: Prevalence and change in AIDS high risk behavior among gay and bisexual men. Stockholm: Paper presented at the IV International Conference on AIDS, 1988.

[b] Evans PE, Rutherford GW, Amory JW, *et al:* Does health education work? Stockholm: Paper presented at the IV International Conference on AIDS, 1988.

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mous and 73 (9.7 percent) reported that they were mutually monogamous with the same person over the entire assessment period, 1984 to 1988. Age of respondents in 1984 ranged from 19 to 63 with a mean of 35.7 (S.D. = 8.37). The majority of the sample in 1984 held professional or white collar occupations (77 percent), were Caucasian (91 percent), and had attended some college (68 percent). Mean annual income was $24,000. The study has been approved annually by the Institutional Review Board of the University of California San Francisco; a Certificate of Confidentiality was also obtained from the National Institute of Mental Health to further protect the respondents.

Measures

Sexual Behavior—Respondents were asked to report whether or not they had engaged in each of 22 sexual behaviors in the previous 30 days separately for primary and secondary partners.

Preference for Unprotected Anal Intercourse—Respondents rank ordered preferences for various sexual behaviors. A subject was scored as preferring this activity if he gave it a ranking of 1 (reported by 59.9 percent or 257 of non-monogamous and 74 percent or 54 of monogamous men). *Lifetime diagnosis of a sexually transmitted disease (STD)* was scored as no or yes (37.5 percent or 148 of non-monogamous and 29.6 percent or 21 of monogamous men in the sample).

AIDS Antibody Testing Status—Respondents were asked if they had obtained AIDS antibody testing and knew their test results. Testing status as of 1988 was used for this analysis: 31.9 percent (N = 136) of the non-monogamous men and 22.9 percent (N = 16) of the monogamous men were seropositive, while 41.3 percent (N = 176) of the non-monogamous men and 35.7 percent (N = 25) of the monogamous men were seronegative. The remainder (31 percent) were either not tested or declined to answer the question.

AIDS Prodromal Symptoms—All study respondents were presented with a checklist of 11 possible symptoms of HIV infection and asked to indicate which they had experienced in the last year. The list included the following: new rash, diarrhea, night sweats, weight loss, persistent fever, herpes, shingles, bullous impetigo, fatigue, oral hairy leukoplakia, or oral candidiasis. This was coded as a dichotomous variable: zero or one symptom indicated no symptoms and two or more indicated the presence of symptoms. In 1984, 15 percent (N = 76) of non-monogamous and 16.4 percent (N = 12) of the monogamous men reported one or more AIDS prodromal symptoms.

AIDS Loss—Participants were asked in 1984 to report how many of their friends and acquaintances either currently carried an AIDS diagnosis or had died of it; 36.3 percent (N = 155) of the non-monogamous and 35.2 percent (N = 25) of the monogamous men reported two or more such individuals.

Health belief variables included the following: *Belief in AIDS Health Guidelines* assessed the respondent's agreement to eight items on a six-point scale with AIDS risk reduction guidelines (Cronbach's alpha = .70, range = 8 to 48, median = 43); *Personal Efficacy* assessed the respondent's perceptions to 13 items on a six-point scale of being able to control risk for HIV infection and perceived self control in high risk sexual situations (Cronbach's alpha = .85, range = 21 to 78, median = 56); *Perceived Susceptibility to AIDS* assessed individual's belief to six items on a six-point scale that they were personally susceptible to contracting AIDS (Cronbach's alpha = .72, range = 6 to 36, median = 25).

Depression (measured by the Brief Symptom Inventory, expressed on a five-point scale using mean scores on six items, range = .17 to 3.67, median = .50).

Two separate scales were used to assess social support for risk reduction. *Social Support-Health Promotion* asked subjects to report how many of their friends engaged in four health-promoting behaviors (Cronbach's alpha = .68, range = 2 to 16, median = 11.0); *Social Support-High Risk Behavior* measured how many friends engaged in each of six potentially health-impairing behaviors (Cronbach's alpha = .72, range = 1 to 21, median = 10).

Statistical Analyses

We chose unprotected anal intercourse (receptive or insertive) as the primary dependent variable of interest because of its proven relationship with seroconversion.[1,12–14,c] Subjects were categorized as having practiced this behavior if they reported one or more episodes of anal intercourse without a condom in the previous month with either a primary or a secondary partner. Bivariate cross-sectional relationships were examined between predictor variables and occurrence of the dependent variables using 2 × 2 contingency tables, from which were calculated odds ratios and 95% confidence intervals using SPSS-X, Version 3.1. All independent variables were scored dichotomously; continuous scale scores were divided at the median. No differences in outcomes were produced with the scales used continuously or dichotomously. Bivariate associations whose 95% CI did not include one were then entered into multiple logistic regressions to calculate adjusted odds ratios with 95% CI; these were calculated using BMDPLR, Version 1987. A logistic regression model using all variables was also calculated. This resulted in a smaller N (308 for cross-sectional analyses; 146 for longitudinal analyses for those at high risk in 1984, 152 for those not at high risk in 1984). We report here the results from both the limited and full logistic models, since the former includes more subjects and the latter may bias variable analyses less.[15] Predictor analyses were completed separately for non-monogamous men who practiced unprotected anal intercourse in 1984 (N = 212) and for those non-monogamous men who did not practice unprotected anal intercourse in 1984 (N = 214).

Analysis of Attrition Bias—Subjects in this analysis did not differ significantly from deceased subjects or those lost to follow-up on any of the sexual behavior variables reported in this paper. Deceased subjects were older (62.1 percent > 36 years; compared to 46.5 percent of the sample and 39.5 percent of lost), more likely to have been diagnosed with a sexually transmitted disease (57.7 vs 36.3 percent of the sample and 40.3 percent of lost), more likely to believe that they had been exposed to HIV (77.2 vs 58.5 percent of the sample and 59.3 percent of lost), more likely to report prodromal symptoms (31.7 vs 15 percent of the sample and 17.1 percent of lost), and more likely to perceive themselves as susceptible to AIDS (61.8 percent above the median vs 46 percent of the sample and 45.4 percent of lost).

Results

AIDS-Related Risk Behavior: 1984–1988—Figure 1 presents the percent of non-monogamous men reporting various

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[c] Hessol N, Rutherford G, Lifson A, *et al:* The natural history of human immunodeficiency virus infection in a cohort of homosexual and bisexual men. Stockholm: Paper presented at the IV International Meeting on AIDS, 1988.

sexual practices in the previous month for all five assessments.

Evident in the graph is the dramatic reduction in unprotected anal intercourse (from 49.8 percent in 1984 to 12 percent in 1988), and the increases in protected anal intercourse (from 15.2 percent in 1984 to 23.8 percent in 1988) and celibacy (from 13.3 percent in 1984 to 18.6 percent in 1988). Figure 2 presents the percent of monogamous men reporting various sexual practices in the previous month for all five assessments.

Monogamous men were more likely to practice unprotected anal intercourse in 1984 (odds ratio = 2.44, 95% CI = 1.44, 4.12) and in 1988 (odds ratio = 2.75, 95% CI = 1.52, 4.97) and were less likely to practice protected anal intercourse in 1984 (odds ratio = 0.41, 95% CI = 0.16, 1.08) and in 1988 (odds ratio = 0.44, 95% CI = 0.21, 0.94). The non-monogamous men were more likely to be celibate in 1984 (odds ratio = 0.18, 95% CI = 0.04, 0.77) but not in 1988 (odds ratio = 0.77, 95% CI = 0.39, 1.53). Monogamous men, compared to non-monogamous men, were more likely to report in 1984 that unprotected anal intercourse was their favorite sexual activity (74 vs 59.9 percent, odds ratio = 1.9, 95% CI = 1.08, 3.32), to be above the median in personal efficacy (68 percent above the median vs 46 percent, odds ratio = 2.49, 95% CI = 1.43, 4.34) and less likely to believe that they were exposed to HIV (40.3 vs 61.5 percent, odds ratio = 0.42, 95% CI = 0.24, 0.72). Monogamous men were less apt to be depressed (21. 9 percent above the median vs 47.2 percent, odds ratio = 0.31, 95% CI = 0.17, 0.56), or to believe that they were susceptible to AIDS (31.4 percent above the median vs 48.5 percent, odds ratio = 0.49, 95% CI = 0.28, 0.84).

Cross-Sectional Predictors of Unprotected Anal Intercourse: 1984—Table 1 presents the bivariate relationships between each of the predictor variables and the practice of unprotected anal intercourse for the non-monogamous men. Adjusted odds ratios from the full regressions are also presented. Those who were younger, who reported that unprotected anal intercourse was their favorite sexual activity, who were lower in personal efficacy, and who were less depressed were more likely to practice unprotected anal intercourse. The limited multivariate analysis revealed the following variables to be related to the practice of unprotected anal intercourse in 1984: younger age (adjusted odds ratio = 0.54, 95% CI = 0.34, 0.87), unprotected anal intercourse as a favorite sexual activity (adjusted odds ratio = 6.92, 95% CI = 3.45, 9.18), and personal efficacy (adjusted odds ratio = 0.41, 95% CI = 0.26, 0.66). Monogamous men were more likely to practice unprotected anal intercourse in 1984 if they reported it to be their favorite sexual behavior (odds ratio = 5.97, 95% CI = 1.84, 19.34).

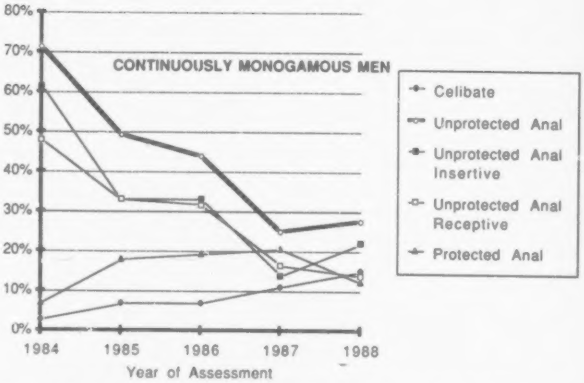

FIGURE 2—Percent of Monogamous Men Reporting Unprotected and Protected Anal Intercourse and Celibacy at Each Annual Assessment

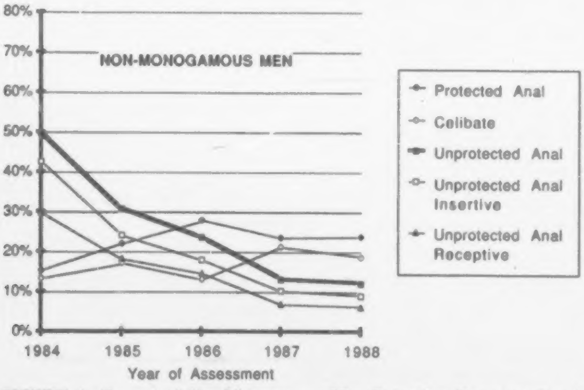

FIGURE 1—Percent of Non-Monogamous Men Reporting Unprotected and Protected Anal Intercourse and Celibacy at Each Annual Assessment

Predictors of Change in Practice of Unprotected Anal Intercourse: 1984–88

Subjects Practicing Unprotected Anal Intercourse in 1984—There were 19.4 percent (N = 41) of the non-monogamous subjects reported practicing unprotected anal intercourse in 1988. Table 2 presents bivariate odds ratios and adjusted odds ratios from the full multivariate model to describe relationships between 1984 predictor variables and the practice of anal intercourse in 1988 for those subjects who reported unprotected anal intercourse in 1984. Unprotected anal intercourse as a favorite sexual activity predicted the practice of anal intercourse four years later. In addition, learning that one was seropositive and experiencing AIDS prodromal symptoms predicted decreased practice of unprotected anal intercourse. The adjusted odds ratios from the limited multivariate analysis were as follows: unprotected anal intercourse as a favorite sexual activity (8.26, 95% CI = 1.88, 36.23) and diagnosed as seropositive (0.37, 95% CI = 0.14, 0.99). Monogamous men who practiced unprotected anal intercourse in 1984 but did not practice it in 1988 were more likely to have been diagnosed as HIV antibody positive (odds ratio = 0.54, 95% CI = .40, .74), while those who tested antibody negative were more likely to continue the practice (odds ratio = 4.44, 95% CI = 1.25, 15.82).

Subjects Not Practicing Unprotected Anal Intercourse in 1984—Among non-monogamous subjects not practicing unprotected anal intercourse in 1984, 5.3 percent (N = 11) reported practicing this behavior in 1988. The only 1984 variable to predict this behavior in 1988 was unprotected anal intercourse as a favorite sexual behavior (odds ratio = 4.21, 95% CI = 1.08, 16.37).

Discussion

Public health campaigns designed to reduce HIV transmission through sexual relations may benefit from the examination of results such as these. Men who initially practiced unprotected anal intercourse outside of a mutually monogamous relationship, even in 1984 when risk information was disseminated widely, preferred unprotected anal intercourse,

TABLE 1—Cross-sectional Predictors of Unprotected Anal Intercourse in 1984 among Non-monogamous Men

Predictor Variables (1984)	Percent (N) Reporting Unprotected Anal Intercourse above Predictor Variable Cutoff	Bivariate Odds Ratio (95% CI)	Adjusted Odds Ratio[b] (95% CI)
Age (>36 years)	37.6 (79)[a]	0.53 (0.36, 0.78)	0.51 (0.29, 0.86)
Unprotected Anal Intercourse-Favorite	79.1 (167)	5.37 (3.49, 8.26)	5.98 (3.46, 10.49)
History of STDs (≥1)	41.5 (80)	1.37 (0.91, 2.07)	1.42 (0.81, 2.46)
Believe Exposed to HIV	65.8 (131)	1.44 (0.96, 2.16)	1.43 (0.79, 2.56)
Prodromal Symptoms (≥1)	16.5 (35)	1.36 (0.79, 2.34)	1.48 (0.66, 3.31)
Personal Efficacy (>mdn)	38.7 (77)	0.42 (0.27, 0.62)	0.36 (0.21, 0.62)
Support-Health Promotion (>mdn)	50.5 (104)	1.10 (0.75, 1.62)	1.38 (0.80, 2.38)
Support-Health Risk (>mdn)	51.9 (108)	1.97 (1.33, 2.92)	1.48 (0.85, 2.57)
Health Guideline Knowledge (>mdn)	42.1 (80)	0.57 (0.38, 0.85)	0.96 (0.60, 1.78)
Personal Susceptibility (>mdn)	46.0 (91)	0.85 (0.57, 1.26)	0.65 (0.37, 1.13)
Depression (>mdn)	44.5 (94)	0.79 (0.54, 1.16)	0.51 (0.29, 0.89)
AIDS Loss (≥1)	32.2 (67)	0.71 (0.48, 1.06)	0.62 (0.36, 1.07)

[a] Total Ns vary from 384 to 421 due to missing data.
[b] n = 308 (152 not practicing unprotected intercourse and 156 practicing unprotected intercourse) due to the necessity of having all cases with complete data on every variable for the complete multivariate model.

TABLE 2—Predictors from 1984 of Unprotected Anal Intercourse in 1988 among Non-monogamous Men Who Practiced Unprotected Anal Intercourse in 1984

Predictor Variables (1984)	Percent (N) Reporting Unprotected Anal Intercourse above Predictor Variable Cutoff	Bivariate Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)[b]
Age (≥36 years)	43.9 (18)[a]	0.85 (0.43, 1.69)	1.06 (0.36, 3.12)
Unprotected Anal Intercourse-Favorite	95.1 (39)	6.39 (1.48, 27.64)	8.21 (1.42, 47.28)
History of STDs (≥1)	32.4 (11)	0.62 (0.28, 1.36)	1.09 (0.37, 3.19)
Believe Exposed to HIV	55.0 (22)	0.56 (0.27, 1.14)	0.56 (0.24, 2.11)
Prodromal Symptoms (≥1)	20.0 (7)	1.05 (0.42, 2.61)	5.10 (1.31, 19.84)
Personal Efficacy (>mdn)	60.0 (24)	1.68 (0.83, 3.41)	2.03 (0.73, 5.67)
Support-Health Promotion (>mdn)	15.4 (67)	0.46 (0.18, 1.18)	0.31 (0.09, 1.04)
Support-Health Risk (>mdn)	47.5 (19)	1.36 (0.68, 2.73)	0.70 (0.24, 2.03)
Health Guidelines Knowledge (>mdn)	55.6 (20)	1.46 (0.70, 3.03)	2.11 (0.70, 6.35)
Personal Susceptibility (>mdn)	50.0 (20)	1.22 (0.61, 2.45)	1.34 (0.47, 3.79)
Depression (>mdn)	36.6 (15)	0.66 (0.33, 1.34)	0.38 (0.13, 1.12)
AIDS Loss (≥1)	33.3 (13)	1.06 (0.51, 2.23)	0.72 (0.24, 2.11)
Diagnosed as HIV+	22.0 (9)	0.36 (0.16, 0.82)	0.16 (0.04, 0.59)
Diagnosed as HIV−	48.8 (20)	2.05 (1.02, 4.11)	0.61 (0.19, 1.90)

[a] Total NS vary from 190 to 211 due to missing data.
[b] n = 146 (29 practicing unprotected intercourse and 117 not practicing unprotected intercourse).

had less personal efficacy, were younger, reported that their friends were more likely to engage in high-risk behavior, and had less belief in the importance of the health guidelines. The continued practice of unprotected anal intercourse over time was associated with preference for unprotected anal intercourse and a diagnosis of being seronegative, while a seropositive diagnosis was associated with a reduction in this behavior. Risk reduction programs may need to eroticize alternative sexual practices,[d] promote skills that increase self-efficacy,[16] modify social norms supporting high-risk behavior,[17] and encourage antibody testing so that seropositive individuals are further reinforced to reduce sexual behaviors likely to infect others with HIV.[18–22]

Unprotected anal intercourse as a favorite sexual activity strongly predicted this high-risk behavior both cross-sectionally and longitudinally. Clearly, pre-existent habit patterns and preferences promote continuation of other behaviors that are detrimental to health. Models developed for smoking cessation and alcohol addiction may be adapted to intervene in this new health threat.

Additionally, those who practiced high-risk behavior are supported by the norms they perceive in their social world. Men who initially perceived their friends and social contacts to engage in high-risk behavior were more likely to practice high-risk sex. Norms can influence behavior in two ways. First, individuals may hold norms supporting safer sex, but not share them with peers. In this instance, interpersonal mechanisms are needed for making implicit norms explicit. Secondly, some explicit norms may not support safer sex. In those cases, strategies may be needed that replace these norms with explicit norms for safer sex.[17]

The belief that one is personally capable of implementing safe sex practices may be necessary for behavior change. Self-efficacy was associated with lower risk cross-sectionally in 1984. Our self-efficacy items tapped the individual's skill in engaging in safer sexual practices as well as the ability to negotiate safer sex with potential sexual partners. Methods for increasing self-efficacy, especially through skill training, may reinforce HIV sexual behavioral risk reduction.

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[d] D'Eramo JE, Quadland MD, Shatts, W, Schuman R, and Jacobs R: The 800 men project: A systematic evaluation of AIDS prevention programs demonstrating the efficacy of erotic, sexually explicit safer sex education on gay and bisexual men at risk for AIDS. Stockholm, Sweden: Paper presented at the IV International Conference on AIDS, June 1988.

Knowledge of positive HIV antibody status was associated with reduction of sexual risk. Offering antibody testing and encouraging individuals to act on their knowledge of test results may be regarded as helpful components of an overall community behavioral health program. Receipt of test results took place in the social and legal context of HIV testing in San Francisco. Testing was available under conditions of anonymity (88 percent of the group received test results at Alternative Test Sites which used anonymous procedures) or, at the very least, confidentiality. Legal guarantees of non-discrimination based either on sexual preference or HIV antibody status have been provided in San Francisco and in California. Testing and counseling takes place in a community context of mass public education about AIDS risk reduction. Antibody testing may result in beneficial behavior change, but perhaps only when such additional resources and assurances are provided.[20,e] Knowledge of seronegative status was associated in the bivariate analyses with increased practices of unprotected anal intercourse. It was not possible, however, to determine the meaning of this finding. It might have been the case that seronegative individuals, upon learning their serostatus, sought out other seronegative men to practice their favorite behavior, or were tested upon beginning a relationship. At any rate, the potential for "silent infection" in some seronegative men should suggest that these men exercise great caution in practicing highly risky activities to avoid seroconversion.[23]

Being in a monogamous gay relationship was associated with higher risk sex throughout the entire study. The interaction of sexuality and relationship is a complex one. Other authors have reported a decrease in overall sex activity within longer term primary relationships, both heterosexual and homosexual.[24,25] However, for these respondents, the establishment of trust in a primary bond and mutual support for specific sexual habits and tastes may have led to increased sexual risk activity.

This sample may have limited generalizability in that it includes predominantly White gay males who are educated and living in San Francisco. Clearly, similar research with other groups in other cities is needed to determine if these or other factors are related longitudinally with behavior change. A recent review of behavioral factors in HIV infection[9] found the field confounded by different conceptualizations and operationalizations of concepts. Needed are standardized instruments to be applied to different communities so that the generalizability of elements of behavior change across groups and communities can be determined.[26] Missing from this analysis were data regarding alcohol and drug usage, and their relationship to high-risk sex. These variables have been found to be strongly associated in previous work.[27–29] Regrettably, because they were not included in our baseline questionnaire, they do not appear in this multivariate model. Future studies of high-risk behavior would profit from analysis of the additional contribution of drug and alcohol use in the context of the psychological and social variables already described here. Since these are self-report data, issues of social desirability with regard to reports of sexual behavior need to be considered. When these respondents were recruited they were given thorough reassurances of confidentially, and they have been followed with repeat assessments for many years, giving us less reason to suspect dishonest reporting. Analyses comparing those who dropped out with continuers found few significant differences in reported frequencies of target sex behaviors. Although the magnitude of change in sexual behavior cannot be determined precisely by self-report methods, the trends described by this research closely parallel changes described in other behavioral studies in San Francisco described above.

ACKNOWLEDGMENTS

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Public Health Briefs

The Mortality Profile of Black Seventh-Day Adventists Residing in Metropolitan Atlanta: A Pilot Study

FREDERICK G. MURPHY, MSPH, MPIA, DANIEL S. BLUMENTHAL, MD, MPH,
JOANN DICKSON-SMITH, MSPH, AND RALPH P. PEAY, MPH

Abstract: Mortality information was gathered for 110 Black Seventh-day Adventist members of seven churches in Metropolitan Atlanta, Georgia during the period 1980–87. Seventy-seven percent of the deaths were due to cardiovascular diseases; 8 percent due to cancer, the second leading cause of death. The cancer rate is extremely low in comparison to the proportion of deaths due to cardiovascular diseases. Subsequent research on this population will take into consideration lifestyle factors which could contribute to this finding. (*Am J Public Health* 1990; 80:984–985.)

Introduction

Differences in mortality rates and life expectancy between Black and White Americans are well known,[1–4] as are reduced disease specific mortality rates among certain religious groups whose lifestyles protect them from various risk factors.[5,6] Black Seventh-day Adventists are a group whose race is at high risk for early death but whose lifestyle may reduce that risk substantially. Black Seventh-day Adventists residing in the Metropolitan Atlanta, Georgia area who are members of the South Atlantic Conference of Seventh-day Adventists have not been previously studied.

Seventh-day Adventist doctrine warns its members, for reasons of health and temperance, not to consume caffeine, tobacco, alcohol, illegal drugs, or pork products.[7–9] Although vegetarianism is not required, it is highly recommended. The doctrine also warns against seeking entertainment in establishments where consumption of proscribed substances take place. It further indicates that health risks can result from such attendance.[6,10] This brief investigation examines mortality among Black Seventh-day Adventists living in Metropolitan Atlanta, Georgia during the seven-year period 1980–87.

Methods

The seven Black Seventh-day Adventist churches included in this study are established members of the South Atlantic Conference of Seventh-day Adventists also based in Atlanta, Georgia. Black Seventh-day Adventist membership in Atlanta grew from 3,366 in 1980 to 6,002 in 1987. Three of the seven churches were established after 1984.

All deaths among members of Adventist churches are reported to regional conferences on a quarterly basis by church clerks. This is part of a conference policy which requires each of its churches to report the names of all individuals dropped from church rolls due to death, apostasy, or lack of attendance. The death portion of these reports contain only the name of the deceased individual, the year of death, and the church with which he/she was affiliated.

We manually retrieved all quarterly reports submitted to the South Atlantic Conference Office between the years 1980 and 1987. Death information and data from each of these were then matched to death certificates at the Georgia Department of Vital Records. Data on the decedents' age at death, sex, and race were obtained from each available death certificate.

Results

Reports of 116 deaths were obtained from the South Atlantic Conference of Seventh-day Adventist. The year of death was not listed for six and could not be matched to death certificates in the State of Georgia Department of Vital Records. We were able to match the remaining 110.

Table 1 shows the distribution and average age at death by sex for the 110 matched death certificates. The female predominance is consistent with the approximately 2:1 (female:male) ratio in Black Seventh-day Adventist church membership in Atlanta.

Table 2 shows the number of deaths attributed to each

TABLE 1—Distribution of Deaths and Average Age at Death by Sex, Metropolitan Atlanta Seventh Day Adventists

Sex	Number of Deaths	Age at Death (years)		
		Average	Median	Range
Male	42	66.4	59	50–96
Female	68	77.4	71	55–104
Total	110	71.5	70	50–104

Metro-Atlanta Minority SDA Mortality Profile

From the Morehouse School of Medicine, Department of Community Health and Preventive Medicine, and the South Atlantic Conference of Seventh-Day Adventist in Atlanta, GA. Address reprint requests to Frederick G. Murphy, MSPH, Division of Diabetes Translation, Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control, 1600 Clifton Road, Mailstop E-08 Atlanta, GA 30333. Mr. Murphy was lead public health investigator for this pilot study and community organizer at Morehouse School of Medicine; Dr. Blumenthal, research consultant for the study, is chairman of the Department of Community Health and Preventive Medicine at Morehouse; Ms. Dickson-Smith, primary researcher for the study, is currently an intervention specialist at CDC; Mr. Peay, research consultant for the study, is currently President of the South Atlantic Conference of Seventh-Day Adventist. This paper, submitted to the Journal July 14, 1989, was revised and accepted for publication January 25, 1990.

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TABLE 2—Total Deaths by Specific Cause and Sex

Cause of Death	Male	Female	ICD Codes A	ICD Codes B	Total
Cardiovascular Disease	29	56	4275	436	85
Lung Cancer	3	3	1629		6
Breast Cancer	—	2	1749		2
Prostate Cancer	1	—	185		1
Pneumonia	2	2	1629		4
Respiratory Failure	—	1	486		1
Homicide	4	—	9654	9554	4
Diabetes	—	1	2500		1
Renal Failure	1	1	1809	7100	2
Accidents	2	1	8120	8140	3
Asthma	—	1	4939		1
Total	42	68			110

Metro-Atlanta Minority SDA Mortality Profile
ICD Code A = Most frequently used code
ICD Code B = Second most frequently used code

specific cause of mortality. Cardiovascular disease accounted for 82.3 percent of the deaths in women and 69 percent in men. All four of the homicide deaths were among males.

Discussion

Although based on relatively small numbers of deaths, the results are suggestive. For example, cancer deaths were relatively rare in this pilot study. This could be attributed, at least in part, to abstinence from use of tobacco and alcohol, and a relatively low-fat diet (due to a high prevalence of vegetarianism) among Seventh-day Adventists.[6,8,9,11] This high proportion of cardiovascular disease deaths among this group could be the result of the large number of elderly persons in the group.

Additional research focused on Black Seventh-day Adventists will be required in larger numbers so that more detailed information can be gathered. Phase II of this investigation is currently being proposed.

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Disaster Medical Assistant Team Formed in Atlanta

An Adult Disaster Medical Assistance Team has been formed in Atlanta, Georgia, as part of the National Disaster Medical System, a joint effort of a number of federal agencies. The system will provide help in the event of a disaster large enough to overwhelm state and local resources.

This team of health volunteer personnel from the greater Atlanta area will function under the supervision of Clayton General Hospital—the hospital designated to help coordinate medical assistance units that travel to disaster sites. This is the second team formed in Atlanta this year. In March, the Henrietta Egleston Hospital for Children formed a Pediatric Disaster Medical Assistance Team.

More information is available from the Office of Emergency Preparedness, HRSA, 5600 Fishers Lane, Rm 14-48, Rockville, MD 20857. Tel: (301) 443-6580.

Playground Hazards in Atlanta Child Care Centers

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Abstract: We identified 684 playground hazards in 66 child care centers despite regulations mandating that the grounds be hazard-free. Of 21 centers with ≤5 hazards, 42.9 percent reported a playground-related injury in the previous year; of 25 centers with 6–11 hazards, 52.0 percent reported a playground-related injury; and of 20 centers with ≥12 hazards, 60.0 percent reported a playground-related injury. Climbing equipment ≥6 feet tall generally had inadequate impact-absorbing undersurfacing and had over twice the rate of fall injuries as climbing equipment <6 feet. (*Am J Public Health* 1990; 80:986–988.)

Introduction

Investigators of medically attended injuries among children attending child care centers found that 47 percent of injuries occurred on the playground.[1] During a 2,000-hour year (40 hours per week × 50 weeks), an estimated 1.64 percent of children in a center will incur a playground-related injury requiring medical evaluation; 0.98 percent will incur a playground equipment-associated injury, and 0.42 percent will incur a climber-related injury.[1] In an attempt to understand why so many injuries occur on playgrounds, we evaluated playground hazards at 66 child care centers.

Methods

The methods of the injury study have been described in detail elsewhere.[1] Briefly, 80 of the 605 licensed centers in Atlanta were randomly selected, and 71 participated in a study of medically attended injuries from June 1987 through May 1988. Of those 71 centers, one had no playground; by the time this study began, one center had replaced its playground, and three centers had closed. Directors of the remaining 66 centers allowed us to evaluate their playgrounds.

Between July and October 1988, two of three evaluators (KWH, LSC, and JMB) visited each participating center. Safety hazards evaluated are listed in Table 1 and included those defined by the Statewide Comprehensive Injury Prevention Program of the Massachusetts Department of Public Health and others.[2–5] Any hazards from playground changes made after March 1, 1988 were excluded from analysis. After the inspection, the director was shown the safety problems identified and given information about playground safety.

Equipment height was measured from the ground to the maximum height that a child's feet can reach. The undersurface (grass, sand, wood chips, etc.) below each piece of equipment was recorded. The undersurface's minimum depth was measured below the point of maximum attainable height.

TABLE 1—Playground Equipment-associated Hazards Identified, Atlanta Child Care Centers, 1988

	Number of Times Identified	
Type of Equipment-associated Hazard	All Equipment	Climbers Only
Rock, concrete, root or stump in fall zone	171	35
Inadequate clearance*	56	30
Sharp protrusion	42	17
Contaminants in undersurface	38	9
Missing part	31	11
Blunt protrusion	29	14
Trip-and-fall hazard	27	4
Loose parts	21	7
Open "S hook	20	0
Tip-over hazard	18	8
Entrapment hazard	16	12
Hard swing seats	13	0
Broken parts	12	0
Other**	34	10
All equipment-associated hazards	528	157

*Inadequate clearance was defined as an obstruction (fence, wall, etc.) within 4 feet of a climber or within 8 feet of the arc of a swing.

**Other includes all equipment-associated hazards appearing <12 times in surveyed playgrounds.

Results

The 66 centers had 135 playgrounds. At 21 (15.6%) playgrounds we identified no hazards; at 114 playgrounds we identified a median of five hazards (range 1–16). Only one center had no playground hazards identified; the other centers had a median of eight playground hazards (range 1–28).

Hazards Unrelated to Equipment

At 66 (48.9 percent) playgrounds we identified a total of 156 hazards unrelated to equipment (median = 2; range = 1–8). Twenty-eight (20.7 percent) playgrounds had gaps in the fencing wide enough for a child to go through. At 11 playgrounds, children could enter a hazardous area within the playground (e.g., a storage shed). Poison ivy was found on four playgrounds, briars on five, and broken glass on five. Other hazards noted included 33 trip-and-fall hazards, 27 protruding rocks, tree stumps, or concrete pieces; and 23 sharp protrusions.

Equipment-associated Hazards

One hundred and eleven (82.2 percent) playgrounds had an equipment-associated hazard (median = 4; range = 1–13). Although climbers, swings, and slides accounted for 52.2 percent of the equipment (Table 2), they were associated with 65.3 percent of the hazards. Hazards were associated with 36.1 percent of the equipment; by type, swings were the most frequently associated with a hazard, followed by spring riders

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TABLE 2—Playground Equipment: Number of Each Type, Number of Hazards, and Percentage with Hazards, Atlanta Child Care Centers, 1988

Type of Equipment*	Number	Total Number of Hazards Identified	Percentage of Equipment with a Given Number of Hazards** 0	1	≥2
Climbers	249	157	55.4	30.5	14.0
Swings***	165	119	47.9	36.3	15.7
Slides	138	69	66.7	22.5	10.8
Barrels	64	6	90.6	9.4	0.0
Seesaws	63	27	65.1	28.6	6.4
Merry-go-rounds	63	33	63.5	22.2	14.3
Spring riders	58	37	51.7	39.7	8.6
Balance beams	47	10	83.0	14.9	2.1
Sand boxes	44	16	75.0	13.6	11.4
Other	166	54	75.3	16.9	7.8
All equipment	1057	528	63.9	25.4	10.7

*Only shown for those types of equipment appearing ≥40 times in surveyed playgrounds.

**Not including inadequacy of undersurface.

***Number of swing seats = 518.

and climbers. The most frequently encountered equipment-associated hazards were hard objects in fall zones (Table 1).

Undersurface below Climbers

The most common surface below climbing equipment was earth or grass (60.6 percent) (Table 3). Impact-absorbing loose-fill materials (e.g., sand or wood chips) were beneath 38.2 percent of climbers, but only 4.2 percent had depths of ≥4 inches. About 27 percent of the climbers were ≥6 feet high and only two (2.9 percent) of those had rubber matting or ≥4 inches of loose-fill material beneath.

Relationship of Hazards to Injuries

During the one-year injury study,[1] of 21 centers with ≤5 hazards, 42.9 percent had reported a playground-related injury; of 25 centers with 6–11 hazards, 52.0 percent reported a playground-related injury; and of 20 centers with ≥12 hazards, 60.0 percent reported a playground-related injury. This same trend was noted for equipment-associated and climber-related hazards and reporting of equipment- and climber-related injuries.

TABLE 3—Surface and Surface Depth Beneath Climbing Equipment, by Height of Climber and Number and Rate of Medically Attended Fall Injuries, Atlanta Child Care Centers, 1988

Surface	Depth (inches)	Number of Climbers by Height (feet) ≤3	4	5	6	7	≥8	Total
Earth/grass	NA	43	40	24	26	12	6	151
Mulch/wood chips/pine straw (inches)								
	≤1	7	12	8	9	2	0	38
	2–3	8	4	3	0	0	0	15
	4–6	1	1	1	1	0	0	4
Sand (inches)								
	≤1	4	3	2	0	0	0	9
	2	0	4	0	3	2	1	10
	3	2	0	1	1	0	0	4
Pea gravel (inches)*								
	≤1	4	2	4	2	1	1	14*
	2	0	0	1	0	0	0	1
Wood Planking	NA	0	1	0	0	0	0	1
Rubber matting	1	0	0	0	1	0	0	1
Total		69	67	44	43	17	8	248*
No. injuries**		1	3	3	3	3	0	13
Fall injuries/100 climbers		1.4	4.5	6.8	7.0	17.6	0.0	

NA = Not applicable.

*Height unknown for one climber with a 1 inch pea gravel undersurface.

**Injuries ascertained from reference 1. Heights of 2 climbers associated with a fall injury were unknown.

We could not identify two involved climbers for 15 climber-related fall injuries reported in the injury study.[1] Of the 13 pieces of climbing equipment associated with a fall injury, 46.2 percent were ≥6 feet compared to 26.4 percent of climbers unassociated with a fall injury. Climbers ≥6 feet tall had 8.8 medically attended fall injuries per 100 pieces of equipment compared to 3.9 per 100 for climbers <6 feet tall (Table 3).

Six other injuries appeared associated with identified hazards. One head injury occurred from a fall from a broken swing seat. A dental injury resulted from a fall off a bridge with no handrail. One fracture occurred from a fall off a 6.3 foot high slide with an earth undersurface and exposed concrete anchoring. One fracture occurred from a fall off a balance beam 3.3 feet above ½ inch of pea gravel. One fracture and one bruise caused by tripping occurred on playgrounds with tripping hazards.

Discussion

At child care centers, most injuries that require medical attention occur on playgrounds.[1,6,7] Of the playgrounds we studied, 84 percent contained a hazard. As the number of hazards increased, so did the likelihood a playground-related injury was reported.

Climbers have been associated with a disproportionate number of playground injuries.[1,6,8–10] Although climbers constituted 23.6 percent of study center equipment, they were involved in 42.5 percent of the equipment-associated injuries.[1] Moreover, the rate of fall injuries increased with the height of the climbing equipment.

In our study, 27 percent of climbers were ≥6 feet high and 61 percent had earth or grass underneath. Earth and grass are not considered suitable undersurfaces for climbers ≥4 feet high.[11–12] If loose-fill material is the undersurface, depths of ≥6 inches are recommended[2,11]; yet, the centers we studied rarely had loose-fill materials at recommended depths. Those responsible for school playgrounds have been found legally negligent for failing to provide adequate undersurfacing beneath equipment.[13]

Despite Georgia State regulations for child care centers mandating that climbing equipment be securely stationed, 5 percent of climbers had tip-over hazards. These regulations require that the playground be fenced; yet, 21 percent of the playgrounds studied had fencing gaps large enough to permit a child to pass through. Although prohibited on center grounds, "hazardous conditions" are not defined in the regulations. Although Georgia codes mandate "resilient surfaces" beneath climbers, they do not specify the types and depths of surfaces that satisfy this definition.

We believe that regulations regarding child care center playgrounds should be more specific and better enforced. In addition, regulators, center directors, and parents should be educated about playground hazards and prevention of playground injuries.[3,14,15]

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A Personal Monitoring Study to Assess Workplace Exposure to Environmental Tobacco Smoke

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Abstract: We enrolled 15 nonsmoking volunteers to evaluate the feasibility of measuring personal exposure to environmental tobacco smoke (ETS) at work and to characterize workplace exposures. During one workshift, we obtained questionnaires on exposure, saliva and urine for cotinine, and personal air samples for respirable particles and nicotine. The levels of cotinine, respirable particles, and nicotine varied widely with self-reports of exposure to ETS, but on average increased with increasing exposure. (*Am J Public Health* 1990; 80:988–990.)

Introduction

While health effects of passive smoking on children and adults have been identified, the principal location of exposure investigated has been the home.[1,2] Workplace exposure has received less attention, and health effects of environmental tobacco smoke (ETS) in the workplace remain controversial.

We enrolled 15 nonsmoking adults to determine the feasibility of measuring personal exposure to ETS at work and to characterize workplace exposures of this small group of subjects. Indicators of exposure, measured during a workday, included questionnaires, personal samples for respirable particles (RSP) and nicotine, and urinary and salivary cotinine.

Methods

Between October 1986 and May 1987, 15 nonsmoking volunteers (eight men, seven women), 18 years of age and older, were recruited from the Albuquerque, New Mexico area. We obtained exposure questionnaires, saliva, urine, and personal air particle samples during one workshift. The saliva and urine specimens were obtained before and after the workshift. Cotinine was quantitated by a double antibody radioimmunoassay, as described by Langone, *et al.*[3] Details of the assay in our laboratory have been reported previously.[4]

During the workshift, each subject wore a personal monitoring pump running at 1.7 l/min with a 10 mm nylon cyclone clipped to the shirt collar.[5] RSP samples were collected on 37 mm Fluropore filters (Millipore Corp). Nicotine was collected on a glass fiber backup filter treated with sodium bisulfate to minimize volatilization; after extraction from the filter, analysis for nicotine was done on a gas chromatograph with a flame ionization detector.[6] The recovery of nicotine by this procedure has been shown to be 98 percent efficient.

From the questionnaires, we derived measures of exposure including the total number of cigarette smokers and total number of hours exposed during the workshift. To describe the relationships among the measures of ETS exposure, Spearman correlations were calculated. Data analysis was performed with standard programs.[7]

Results

Occupations of the subjects were diverse (Table 1); mean age was 44.8 years; average duration of the workshift and of the personal monitoring was 6.5 hours (SD ± 2.0).

Exposure to cigarette smokers at work was reported by 13 of the 15 participants. Of the 13 reporting exposure, two reported exposure to crowds of smokers during their workshift and the remaining 11 encountered a mean of 8.8 smokers (SD ± 6.7). The mean reported hours of exposure was 3.4 (SD ± 2.1).

Respirable particle and nicotine concentrations varied widely with the reported number of smokers and hours of exposure. The mean concentrations for RSP and nicotine were 63.9 $\mu g/m^3$ (SD ± 41.5) and 20.4 $\mu g/m^3$ (SD ± 20.6), respectively. Correlations between the atmospheric markers

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TABLE 1—Description of Participants in a Personal Monitoring Study of Exposure to Environmental Tobacco Smoke at Work, New Mexico, 1986–87

Occupation/Workplace	Workshift Duration/ Exposure Duration (hours)	RSP (μg/m^3)	Nicotine (μg/m^3)
Males			
Physician/Hospital	8/5	52.3	10.0
Social Worker/Office	8/0	44.0	2.5
Stock Broker/Office	8/2	69.4	7.2
Bus Boy/Restaurant	8/8	145.8	45.0
Maintenance Worker/Retail Store	8/3	85.2	6.9
Barber/Barber Shop	8/0	14.7	4.0
Barber/Barber Shop	8/4	145.8	13.7
Volunteer/Hospital	4/2	80.0	46.0
Females			
Interviewer/Public Transportation	3/2	4.0	0.0
Travel Agent/Office	8/5	65.7	50.0
Travel Agent/Office	6/4	62.1	46.7
Attorney/Office	8/6	63.3	5.9
Volunteer/Hospital	4/3	27.6	6.3
Volunteer/Hospital	4/3	25.2	8.7
Volunteer/Hospital	4/4	53.2	53.2

and the questionnaire measures of exposure to ETS were moderate (Table 2).

As was observed for the atmospheric markers, the post-workshift urinary and salivary cotinine levels varied widely with self-reported exposure. In comparison with pre-workshift levels, post-workshift levels were not consistently increased. The mean pre-workshift urinary and salivary cotinine concentrations were 31.8 ng/mg Cr (SD ± 67.6) and 2.9 ng/ml (SD ± 5.0), respectively. For the post-workshift levels, the corresponding values were 19.7 ng/mg Cr (SD ± 43.2) and 3.5 ng/ml (SD ± 5.9).

Spearman correlation coefficients were calculated to examine the relations among the questionnaire variables, the atmospheric markers, and urinary and salivary cotinine (Table 2). Moderate correlations were obtained for self-reports and cotinine levels, and nicotine levels and cotinine levels. However, RSP levels and cotinine concentrations were not correlated.

TABLE 2—Spearman Correlations between Various Measures of Environmental Tobacco Smoke at Work, New Mexico, 1986–87

Correlated Measures	N	r
RSP (μg/m^3) with:		
Nicotine	15	0.57*
Total number of smokers	15	0.44
Total hours of exposure	15	0.53*
Postshift urinary cotinine	14	0.05
Postshift salivary cotinine	11	−0.07
Nicotine (μg/m^3) with:		
Total number of smokers	15	0.62*
Total hours of exposure	15	0.54*
Postshift urinary cotinine	14	0.60*
Postshift salivary cotinine	11	0.46
Postshift urinary cotinine (ng/mg Cr) with:		
Total number of smokers	14	0.39
Total hours of exposure	14	0.57*
Postshift salivary cotinine (ng/ml) with:		
Total number of smokers	11	0.63*
Total hours of exposure	11	0.45

*$p < 0.05$

Discussion

The controversial effects of involuntary smoking in the workplace need further investigation. The conduct of such research would be facilitated by the development of unintrusive and accurate methods of exposure assessment. Alternative approaches include active and passive monitoring, biological markers, and questionnaires. We have shown that personal monitoring for tobacco smoke components can be accomplished in the workplace. However, many employers and employees would not participate in the study because of concern about the wearing of pumps.

Despite the small number of subjects studied in this investigation, objective evidence of exposure to ETS was obtained in various workplaces. The levels of RSP and nicotine were similar to those observed in other investigations.[6,8–10] However, few of these studies included information on the intensity and duration of exposure to ETS.[10]

We observed moderate positive correlations among the questionnaire measures of ETS exposure, the results of personal monitoring for RSP and nicotine, and measurements of urinary cotinine. Each of these types of measures provides a differing index of exposure to ETS.[1] The questionnaire measures that were used assess source strength, but concentrations of ETS are also influenced by room volume and ventilation. Nicotine is a specific marker of exposure to ETS, whereas RSP is nonspecific. Cotinine levels reflect nicotine exposure, but also are determined by timing of specimen collection[10] and uptake and metabolism. Thus, tight concordance among these broad indicators of exposure used in this study would not be anticipated.

Because of the differing characteristics of questionnaires, personal monitoring, and biological markers for assessing ETS exposure, no single method should be considered as optimal for studying the workplace. We recommend that assessment of ETS exposure in indoor environments should utilize multiple approaches to characterize short- and long-term exposures. In population studies, questionnaire measures of exposure offer the simplest approach with personal atmospheric markers and biologic markers providing methods for estimating the potential magnitude of misclassification of self-reported exposure.

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Sexual Histories of Heterosexual Couples with One HIV-Infected Partner

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Abstract: Ninety-eight heterosexual couples enrolled in a HIV transmission study, at least one of whom was HIV-infected, were interviewed about sexual behavior. Although males and females were interviewed separately, there was agreement between them on the number of sexual contacts, the practice or anal intercourse, and condom use. These findings of strong reliability are encouraging, but do not necessarily imply that the data are valid. (*Am J Public Health* 1990; 80:990–991.)

Introduction

The best way to prevent the spread of infection from human immunodeficiency virus (HIV) is voluntary behavioral change.[1] Before recommending strategies to promote such changes, one must first establish the kinds of behavior currently practiced. To do so, AIDS (acquired immunodeficiency syndrome) researchers rely almost exclusively on interviewing techniques, but many question the validity and reliability of this methodology.[2] For example, in a study of the reproductive histories of a group of women, Hornsby and Wilcox[3] established that daily logs of sexual behavior were more accurate than comparable data collected through retrospective interviews. Similar results were found by both Udry and Morris[4] and Kunin and Ames,[5] who determined that recent and frequent reporting of sexual behavior produced the most precise results. However, AIDS epidemiologists may not have the opportunity to collect data on a regular basis and are thus forced to rely on retrospective reports of behavior even though the accuracy of these reports (especially for a variety of sexual practices) has not been established. Here I report on the reliability of such data, comparing reports of sexual behavior between men and women in couples of which at least one partner was HIV seropositive.

Methods

Since 1985 we have been conducting a study of the heterosexual transmission of acquired immunodeficiency syndrome (AIDS) in California in which we enroll the opposite sex partners of individuals infected with HIV. Although the study began by enrolling the female partners of HIV-infected men,[6] in 1987 we began to enroll participants as couples. Individuals who test positive for HIV at a variety of sites and who also have heterosexual partners are referred to the study as part of their post-test counseling. Enrollment is voluntary; study protocol is described elsewhere.[6]

Interviewers are female and are matched to couples by ethnicity. They are trained in group and individual sessions that include role playing and interpretation of interview responses. Results were reliable across interviewers. To ascertain number of sexual contacts, the interviewer asks how many times the couple has sexual intercourse in a typical week or month. Deviations from this number throughout the relationship are noted. The total number of contacts is estimated by multiplying the duration of the relationship by the typical reported amount and weighting this number by changes in sexual activity over time. Individuals in the couple are interviewed separately on the same day.

Behaviors considered in this report are: vaginal intercourse, anal intercourse, and condom use. Continuous responses were compared using Pearson's correlation coefficient, and categorical responses were compared using the Kappa coefficient and its corresponding confidence limits as described by Fleiss.[7] HIV infection was ascertained from serological tests using enzyme immunoassays with Western Blot confirmation.

Results

This report includes data from 98 couples, 68 percent of which were monogamous at entry into the study. Most of the men and women reported only one partner in the six months prior to entry into the study. Median number of partners since 1978 (the beginning of the AIDS epidemic) was five for the women and 10 for the men. The overall male-to-female transmission rate from the study which began in 1985 was 24 percent. Seventy-seven of the couples included infected men and their female partners; 12 (16 percent) of these women were infected. Twenty-one of the couples were infected women and their male partners; none of these men were infected. The reported risk group of the infected partner of the 98 couples varied and is described in Table 1. Sixty-three percent of the couples were White, 20 percent Latino, 7 percent Black, 1 percent Asian, and the remainder were couples of mixed ethnicity. Average income for the couples was $20–29,000 per year; average level of education was 13

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TABLE 1—Risk Group of the HIV-Infected Index Case in 98 Heterosexual Couples

Characteristics	Male N = 77 (%)	Female N = 21 (%)
Bisexual	27 (35)	
Bisexual + Intravenous Drug Use	11 (14)	
Intravenous Drug Use	24 (31)	3 (14)
Heterosexual Partner		10 (48)
Hemophiliac or Transfusion-associated	6 (8)	5 (24)
No Identified Risk	9 (12)	3 (14)

school years. The couples had been together from one month (four contacts) to 19 years (greater than 3,000 contacts).

The total number of vaginal intercourse contacts reported by the man and the woman were highly correlated (r = .84, 95% CI = .64, 1). Because the couples knew they were to be interviewed about their sexual behavior, they may have discussed responses to anticipated questions. In fact, some of their responses were identical, but there was still agreement between those partners with non-identical responses (r = .72 95% CI = .44, 1). Women reported more vaginal contacts than their male partners for the duration of the relationship, but this was not a significant difference (mean estimated number of contacts was 540 by women versus 508 by men). Agreement was stronger for the couples with briefer relationships.

Number of anal intercourse contacts was compared as a continuous variable, with somewhat less strong agreement (r = .44, 95% CI = .13, .74). Responses on anal intercourse as a dichotomous variable (ever versus never) compared using the Kappa coefficient, agreed well (Kappa = .76, 95% CI = .56, .95) (Table 2). Responses on condom use treated as a dichotomous variable (Table 3) also agreed well (Kappa = .74, 95% CI = .54, .94). Two couples who disagreed about the practice of anal intercourse also disagreed about the practice of condom use. The small number of couples and high levels of agreement precluded analyzing differences by risk group of the index case, ethnicity, gender, number of sexual partners, or duration of the relationship.

Discussion

TABLE 2—Practice of Anal Intercourse Reported by Men and by Women Heterosexual Partners, N (proportion)

		Men		
		Ever	Never	Total
Women	Ever	34 (.35)	5 (.05)	39 (.4)
	Never	5 (.05)	54 (.55)	59 (.6)
	Total	39 (.4)	59 (.6)	98

Kappa = .76 (95% CI = .56, .95)

TABLE 3—Condom Use reported by Men and Women Heterosexual Partners, N (proportion)

		Men		
		Ever	Never	Total
Women	Ever	45 (.46)	6 (.06)	51 (.52)
	Never	7 (.07)	40 (.41)	47 (.48)
	Total	52 (.53)	46 (.47)	98

Kappa = .74 (95% CI = .54, .94)

In this group of heterosexual couples with one HIV-infected partner, agreement about sexual practices was observed. Couples agreed somewhat better on the number of contacts of vaginal than anal intercourse. These patterns are similar to those observed by Seage, *et al*[8] in homosexual couples.

Participation was voluntary and the results might not apply to all heterosexual couples with one infected partner. In addition, this evidence of good reliability does not necessarily imply validity. For example, measurements were not independent because couples may have discussed responses prior to the interview.

The occasional disagreement among partners suggests that researchers still must be cautious in relying on the reports of sexual behaviors they are examining. We intend to examine this phenomenon further by assessing willingness to discuss HIV risk and serostatus between partners. Kegeles, *et al*[9] found that HIV-infected homosexual men were not completely forthright in discussing their antibody status with non-primary partners. These results remain to be examined between heterosexual partners.

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Maintenance of Nonsmoking Postpartum by Women Who Stopped Smoking during Pregnancy

Patricia Dolan Mullen, DrPH, Virginia P. Quinn, MPH, and Daniel H. Ershoff, DrPH

Abstract: This paper describes self-reported maintenance of nonsmoking at six months postpartum by women whose abstinence was verified beginning before the 20th week of pregnancy and continuing through delivery (n = 134). The overall maintenance rate of 37 percent was not related to sociodemographic characteristics, smoking and obstetric history, the time when quitting occurred, or a prenatal smoking cessation program. Although this rate is encouraging, more attention should be directed to sustaining prenatal abstinence from smoking beyond delivery. (*Am J Public Health* 1990; 80:992–994.)

Introduction

Many women smokers refrain from smoking while they are pregnant. Randomized trials of prenatal smoking cessation programs have found net differences of 12–25 percentage points,[1–3] with corresponding positive effects on pregnancy outcomes[1,4–6] and health care costs.[6] Even more women who smoked prior to pregnancy (16–41 percent)[1–3,7,8] stop smoking in response to pregnancy before they begin prenatal care, and 65–80 percent of those "spontaneous quitters" maintain abstinence throughout pregnancy.[1,9] Rates of relapse postpartum, however, may be high.[10–13] This is of concern because of growing evidence that parental smoking compromises infant health[14] in addition to that of the mother. This study addresses the following questions:

- How much prenatal smoking cessation is sustained after delivery?
- Do prenatal intervention programs negatively affect postpartum maintenance, as suggested in previous findings?[14]
- What are the characteristics of women who maintain abstinence?
- How soon do women return to smoking?

Methods

All English-speaking pregnant women entering care by the 18th week of pregnancy between July 1985 and June 1987 in one of five health centers of a large multispecialty medical group practice in Los Angeles affiliated with Maxicare Health Plans, Inc, comprised the study population. Those who reported smoking ≥7 cigarettes per week before becoming pregnant (23 percent) were randomly assigned to the experimental program or usual care. Of these (n = 541), 59 percent were intake smokers; 41 percent were spontaneous quitters. Characteristics of the multi-ethnic study subjects are described elsewhere.[3,9] The study tested the effectiveness of a serialized self-help smoking cessation program, the first part of which was given at the intake visit; and the remainder were mailed weekly thereafter.[3]

This analysis is of women who continued their pregnancies as medical group and health plan enrollees and who achieved optimal prenatal smoking cessation (see Table 1). For intake smokers, optimal cessation was defined as quitting before the 20th week of pregnancy. Maintenance for intake smokers and spontaneous quitters was assessed biochemically over the course of pregnancy (average tests per subject = three). Rates of optimal quitting were as follows: Intake smokers, 22.2 percent in the experimental group versus 8.6 percent among the controls; spontaneous quitters, 83.7 versus 78.6 percent.

Data for the present analysis were from a questionnaire and interview at the intake visit and a telephone interview six months after delivery that embedded questions about smoking and other health-related behaviors in questions assessing satisfaction with health services.[3] Postpartum maintenance was defined as self-reported nonsmoking throughout the six months since the birth of the baby. Subpatterns and their prevalence are summarized in Figure 1.

TABLE 1—Sample Attrition by Intake Smoking Status and Experimental Group

	Intake Smokers		Spontaneous Quitters		
	Experimental	Control	Experimental	Control	TOTAL
Randomized for Prenatal Study	165	158	110	108	541
Miscarriage	12	13	9	8	42
Abortion	7	11	4	1	23
Disenrollment/transfer	20	18	10	15	63
Total Sample Size for Analysis in Prenatal Study	126	116	87	84	413
No optimal quit	98	106	15	18	237
Disenrollment/transfer	10	3	12	11	36
Total Eligible for Postpartum Follow-up	18	7	60	55	140
Refused interview	0	1	1	4	6
Total Postpartum Interviews	18	6	59	51	134

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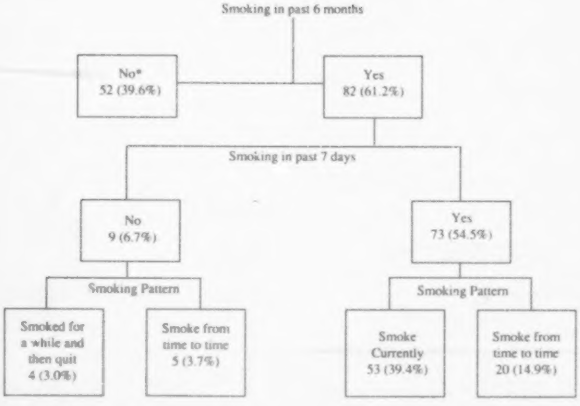

* Classified as maintainer

FIGURE 1—Patterns of Postpartum Smoking among Prenatal Quitters (& of total) (n = 134)

Telephone interviews were completed for 134 of the 140 women (96 percent) eligible for follow-up (see Table 1). Comparison of the 134 subjects for whom data were available with the 32 who disenrolled or refused revealed no significant differences in demographic, obstetric history, or smoking history variables (data available on request to author).

Results

Table 2 describes the characteristics of prenatal quitters. The overall maintenance rate was 37.1 percent. Rates did not differ significantly by intake smoking status. Among the spontaneous quitters, experimental status was not related to maintenance. The number of intake smokers was too small to analyze by experimental group status. There were no statistically significant differences ($p > 0.05$) between maintainers and relapsers in sociodemographic characteristics, smoking history, or obstetric history.

TABLE 2—Background and Other Characteristics of Prenatal Quitters at Time of Prenatal Intake

	Percent
Sociodemographic Variables	
Race	
White	57.5
Black	23.1
Other	19.4
Education	
<High school graduate	17.9
High school graduate	41.8
Some college	30.6
>College graduate	9.7
Married	66.4
Age (years)	
18–19	14.2
20–29	67.2
≥30	18.6
Obstetrical Variables	
Primigravida	29.9
Primipara	59.0
Weeks Entering Care	
≤8	26.8
9–13	57.5
≥14	15.7
Smoking History	
Age Smoking Began (years)	
≤16	42.5
17–20	38.8
≥21	18.7
Prepregnancy Smoking Rate	
≤10 cgts/day	66.4
11–19	9.7
≥20	23.9
>60 Minutes to 1st Cigarette	79.9

Twenty-six percent of the sample reported that they had resumed smoking by the end of the 6th postpartum week (Figure 2). This represented 43 percent of the relapse that occurred. By the end of the third postpartum month, 43 percent had relapsed (71 percent of the six-month total).

Discussion

The findings from this study indicate that some prenatal abstinence is sustained postpartum. Although this is based on self-reported smoking status in the postpartum period, two facts offer reassurance: the sample included women whose reported cessation was validated throughout pregnancy, a more sensitive time to report the behavior; and the focus on smoking was masked by questions about other health practices and the health plan services.

The follow-up period in the present study was shorter than the standard of one year in smoking cessation studies. It is likely that much of the relapse was captured, however, In the National Health Interview Study,[7] 95 percent of return to smoking that was reported at 12 months had occurred by six months; this marked leveling off has been observed elsewhere.[10,15,16] Because of the powerful motivation aroused by the pregnancy, the "post-program" period is defined as beginning with the birth. In fact, however, contact with the program in the present study ceased an average of four months earlier, so the measurement period for the intervention group could be viewed as approaching 12 months. Also, return to work and resumption of alcohol and caffeine, potential sources of stress and cues to smoke, already had occurred in most study subjects. Breastfeeding had ceased for all but one woman.

A strength of this study is the presentation of data on rates of return to smoking in a population with verified and continuous abstinence during pregnancy. Further, the definition of maintenance was relatively conservative.[16] Refusers were counted as smokers.

The rate of nonsmoking postpartum was higher in this study compared to findings from other studies. In the same

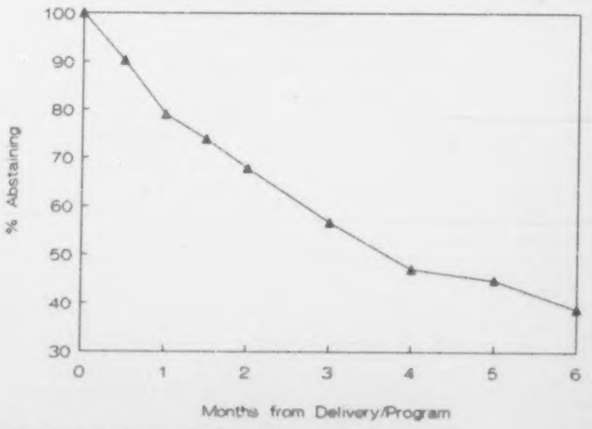

FIGURE 2—Postpartum Smoking Relapse Over Time (n = 134)

TABLE 3—Number and Percent of Prenatal Quitters Who Reported Nonsmoking During the First Six Months Postpartum, by Intake Smoking Status and Experimental Group (n = 140)*

	Intake Smoking Status		
Experimental Group	Intake Smoker	Spontaneous Quitter	TOTAL
Experimental	6/18 = 33.3%	23/60 = 38.3%	29/78 = 37.2%
Control	3/7 = 42.8%	20/55 = 36.4%	23/62 = 37.1%
Total	9/25 = 36.0%	43/115 = 37.4%	52/140 = 37.1%

*Includes six women who refused the interview who were considered to be smokers.

population and with a similar intervention but a point prevalence measure of prenatal cessation, the six-week postpartum maintenance rate was 46 percent versus 74 percent in the present study.[12] The three-month postpartum maintenance rate found in an intervention trial in Baltimore[13] was 25 percent for treatment group members versus 57 percent in the present study. The Baltimore population smoked more heavily before pregnancy, had prenatal smoking status assessed only at the eighth month, and had a more intensive intervention including a home visit which may have boosted short-term quitting artificially.

The present results are similar to those reported for six months postpartum in the two other studies that could be located, the National Health Interview followback study[7] and a followup survey of Minneapolis/St. Paul area birth announcements.[17] Both of these groups included spontaneous quitters and used retrospective reports of smoking status during pregnancy. The definitions of prenatal cessation used in these studies did not preclude cessation of shorter duration than the present study.

Within the limitation of small numbers available for sub-analyses, rates of maintenance appeared to be unrelated to smoking status at the first prenatal visit (intake smokers versus spontaneous quitters). Sexton and coworkers[13] found a higher rate of continued abstinence among spontaneous quitters. Because there might be a rebound effect resulting from the emphasis on cessation to protect the fetus, we looked for but did not find any negative effects of the intervention.

These findings suggest that prenatal smoking cessation does carry over to the postpartum period but that exclusive concentration on the prenatal period is not enough. To capitalize further on the opportunity presented to reduce rates of smoking among young women and to protect the health of their offspring, future research should be directed toward the development and testing of intervention programs for late pregnancy and the early postpartum period.

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Changes in Needle Sharing Behavior among Intravenous Drug Users: San Francisco, 1986–88

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Abstract: We analyzed data for San Francisco intravenous drug users entering treatment, April 1986–September 1988 (N = 7,660). The proportion of cases reporting any needle sharing in the month preceding treatment decreased from 50 percent in 1986 to 28 percent in 1988. Similar decreases were reported by two longitudinal cohorts (needle sharing by the same individuals) admitted in 1986 and 1987 (n = 303), and in 1986 and 1988 (n = 205). In a multiple logistic regression model four variables predicted needle sharing: earlier time of admission, cocaine use, younger age, and being White rather than Black. (*Am J Public Health* 1990; 80:995–997.)

Introduction

Successful and sustained risk reduction among intravenous drug users (IVDUs) is vital in slowing the spread of the human immunodeficiency virus (HIV) in the United States. Injectable drug use is implicated in 27 percent of adult acquired immunodeficiency syndrome (AIDS) cases, and this figure is substantially higher for Blacks (45 percent) and Hispanics (47 percent). Well over half of all heterosexually transmitted cases and pediatric cases are among sexual partners and children of IVDUs.[1]

HIV prevention strategies targeting IVDUs, in addition to drug abuse treatment, now include grassroots efforts,[2] clinic-based interventions,[3,4] street outreach projects,[5] community-based information and awareness campaigns,[6] and publicly supported,[7] and unsanctioned needle exchanges.[8] In New York City, where seroprevalence among IVDUs reached about 60 percent,[9] cross-sectional and ethnographic studies report decreased needle sharing, increased needle cleaning, and increased demand for sterile needles on the streets.[10-13]

In San Francisco, one study found no change in needle sharing for cross-sectional samples drawn in 1985 and 1987,[14] while in three other studies IVDUs self-reported some decrease in sharing.[15-17] We report changes in needle sharing behavior for two samples of IVDUs entering drug detoxification programs in San Francisco for successive time periods from 1986 to 1988, and for two retrospective cohorts repeating treatment during the study period. We also evaluated correlates of needle sharing behavior.

Methods

Study respondents were IVDUs consecutively entering outpatient drug detoxification clinics (San Francisco General Hospital and Haight Ashbury Free Medical Clinic) from April 1986 through September 1988 (N = 7,660). Participants were interviewed on admission concerning demographics, drug use, drug treatment, and the number of needle sharing occasions for the 30-day period preceding admission to treatment. To evaluate change over time, the data were partitioned into consecutive six-month calendar periods, giving a total of five time blocks. The proportion of participants reporting any needle sharing was compared across time periods. The two largest cohorts of treatment repeaters within non-adjacent six-month periods were identified in 1986–87 (n = 303), and in 1986–88 (n = 205).

Logistic regression modeling was applied to identify correlates of needle sharing, using only the first admission for each individual during the study period (n = 5,610). The outcome variable was number of needle sharing occasions in the past month, coded dichotomously to reflect *any* sharing versus *no* sharing. Sex, age, education, ethnicity, cocaine use, number of prior admissions to drug treatment (<3 admissions or 3+ admissions), and time period (coded 1–5) were entered as predictors. Since route of administration was not known for cocaine, this variable reflects cocaine administered by smoking, injection, inhalation, and other routes.

Results

Demographic characteristics reported here reflect only the first admission for each individual within each clinic (n = 5,916). For both clinics combined, most admissions (92 percent) were for heroin use. The separate clinic samples differed in terms of age, ethnicity, education, and drug of choice (Table 1).

For all admissions to both clinics (N = 7,660), the proportion of cases reporting any needle sharing decreased at each successive time period, from 50 percent at Time 1 (April-September 1986) to 28 percent at Time 5 (April-

TABLE 1—Demographic Characteristics for Clinic Samples*

	Clinic	
Demographics	San Francisco General Hospital (n = 2,211)	Haight Ashbury Free Medical Clinic (n = 3,705)
Drug of Choice		
% Heroin	100	87
% Speed/Cocaine/Other	—	13
Ethnicity		
% White	49	66
% Black	27	18
% Latino	20	12
% Asian/Indian	4	4
Education		
% High School or Less	78	64
% Some College	22	36
Sex (% Female)	37	34
Mean Age (years)	36	34

*Based on first admission only within each clinic.

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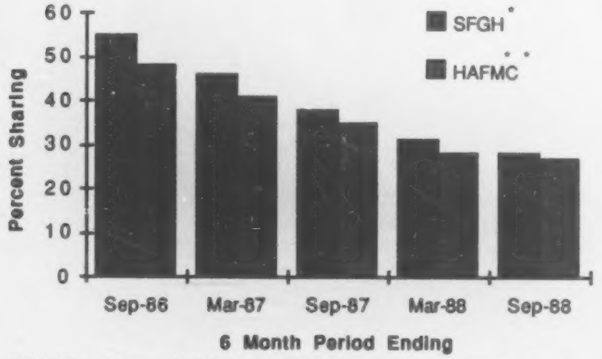

FIGURE 1—Changes in Self-reported Needle Sharing among IVDUs Entering Two San Francisco Outpatient Detoxification Clinics, 1986–88

September 1988). The data for each clinic separately are presented in Figure 1.

Self-reported needle sharing also decreased in individuals seen more than once. For the cohort entering treatment in both 1986 and 1987, the proportion of needle sharers decreased from 52 percent to 35 percent. For the cohort entering treatment in 1986 and 1988, the proportion of sharers decreased from 47 percent to 23 percent.

Frequencies for variables included in the model predicting any needle sharing are given in Table 2, together with a summary of logistic regression results. Four variables predicted needle sharing:

- IVDUs entering treatment at later time periods were less likely to report needle sharing;
- IVDUs reporting any use of cocaine were more likely to report needle sharing;
- older IVDUs were less likely to report needle sharing; and
- Blacks reported less sharing than did Whites.

Discussion

Self-reported needle sharing decreased over time for the total sample (N = 7,660), for each individual clinic sample, for treatment repeaters, and in logistic modeling which considered only first admissions. Consequently, the observed decrease in needle sharing is not likely due to unique characteristics of individual clinic samples, or to the presence of treatment repeaters in samples selected for univariate analyses.

Self-report bias could account for these results. We asked a convenience sample of 20 methadone detoxification participants, after admission to treatment, about underreporting of needle sharing at the time of admission. Most thought that underreporting would occur, but for reasons of social desirability rather than entry into treatment, which implies that these data reflect a lower boundary rather than "true" needle sharing. Collecting data within drug treatment programs also limits generalizability to a large non-treatment population. Of the estimated 16,000 IVDUs in San Francisco,[18] only 5,000 entered treatment in 1987.

The finding of decreased needle sharing behavior over time indicates that many San Francisco IVDUs are reducing risk of HIV infection by modifying needle sharing behavior. These risk-reduction practices, together with increased needle cleaning previously reported among San Francisco IVDUs,[14,19] may account in part for the decrease and leveling of seroconversion in this population from 7 percent per year in 1985 to an estimated 2.4 percent currently.[20] Nevertheless, 30 percent or more of San Francisco IVDUs still admit to the

TABLE 2—Distribution of Predictors and Results of Logistic Regression Analyses (N = 5,610)*

Predictors	Predictor Distributions: Response Value	n	(Percent Sharing)**	Logistic Regression Results+: Units++	OR (95% CI)
Age (years)	<30	1240	(43)	+10 years	0.87 (0.80, 0.94)
	30–39	2943	(40)		
	40–49	1070	(40)		
	50+	357	(28)		
Education (highest grade)	<10	458	(45)	+5 years	1.01 (0.99, 1.03)
	10–14	4566	(40)		
	15+	586	(40)		
Prior Treatment	<3	2799	(41)	<3, ≥3	0.98 (0.87, 1.09)
	≥3	2811	(39)		
Sex	Male	3636	(39)	M/F	0.99 (0.89, 1.12)
	Female	1974	(41)		
Cocaine use	No	3805	(38)	No/Yes	1.41 (1.25, 1.59)
	Yes	1805	(43)		
Black	No	4381	(41)	No/Yes	0.73 (0.63, 0.85)
	Yes	1229	(35)		
Latino	No	4784	(40)	No/Yes	0.99 (0.85, 1.17)
	Yes	826	(41)		
Time period	1	1384	(52)	+6 months	0.77 (0.74, 0.80)
	2	1199	(43)		
	3	1034	(38)		
	4	1071	(32)		
	5	922	(29)		

*Sample includes only the first admission into either clinic, for each individual, during the study period.
**Percentages reflect proportion of cases in each category who reported needle sharing.
+Adjusted odds ratios.
++For continuous variables, sign gives direction of relationship with needle sharing. For dichotomous variables, odds ratio reflects change in units from left to right.

behavior that most effectively facilitates the spread of HIV, signaling the need for a second wave of innovative and aggressive AIDS prevention to include greater emphasis on cleaning needles with bleach, increased collaboration between members of the IVDU subculture and public health workers, and the use of multiple intervention strategies.[21,22]

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AAP Report Examines Medicaid State Reports for 1988

Children in the United States account for about half of Medicaid recipients, but only one-fifth of Medicaid expenditures, according to a recent report issued by the American Academy of Pediatrics. In the analysis, entitled *Medicaid State Reports, Fiscal Year 1988,* AAP says that only 20 percent of children eligible for Medicaid received services under the Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) preventive care program—a decrease of 13 percent from the pervious year.

The compilation of Medicaid reports examines state, regional, and national statistics on children's health, infant mortality, prenatal care, medicaid recipients and cost, and Medicaid program characteristics. The reports (also generated in 1982, 1984, and 1987) assist policy-makers and analysts in assessing their state's Medicaid program in comparison with others.

Reports for single states are available from the APP at no charge. Complete sets of reports for 49 states and the District of Columbia are available for $15 per packet. Individual or complete reports can be obtained by contacting the American Academy of Pediatrics, 141 Northwest Point Blvd., P.O. Box 927, Elk Grove Village, IL 60009-0927. Tel: Carol Kolbaba, 708/981-7945, or Michelle Zajac, 708/981-7389.